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REPORT .

ON THE

TREATMENT OF PLAGUE

WITH

PROF. LUSTIG'S SERUM

AT THE

ARTHUR ROAD HOSPITAL

By

KHAN BAHADUR DR. N. H. CHOKSY,
Special Assistant Health Officer, Bombay Municipality.

Bombay :

PRINTED AT THE "TIMES OF INDIA" PRESS.

1901

With the compliments of

V. M. Choksy

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Letter from the Commissioner, No. 14736, dated the 26th August 1901:—

“I have the honour to forward herewith a copy of the report on cases of Plague treated with Professor Lustig's serum, &c., at the Arthur Road Hospital by Khan Bahadur Dr. N. H. Choksey during the months of February, March, April and May 1901 for the information of the Corporation.”

THE MUNICIPAL COMMISSIONER

FOR THE CITY OF BOMBAY ;

THROUGH THE SPECIAL MEDICAL OFFICER,

PLAGUE OPERATIONS.

SIR,—I have the honour to submit the following report on cases of Plague treated with Professor Lustig's serum at the Arthur Road Hospital during February, March, April, and May 1901:—

1. As some recent researches in bacterio-therapy have contributed to enhance our knowledge of the subject, and at the same time to demonstrate with some accuracy the mode of action of sera in various infections, a brief résumé of the same would not be out of place, inasmuch as these investigations have an important bearing on (1) the serum treatment of plague, (2) the limitations that must be placed on our expectations and (3) the lines along which improvements must be sought for, in order to perfect Lustig's serum.

I. A BRIEF RE'SUME' OF RECENT RESEARCHES IN BACTERIO-THERAPY.

2. Dr. W. Bulloch of the London Hospital has recently summarised the work of various observers, in a series of communications to the medical press* and also before the Pathological Society of London, and the following data have been derived mainly from his contributions, his wording in many cases having been retained intact as it expresses the facts so lucidly and tersely:—

Sero-therapy has shown some successes and notably in the case of diphtheria, the antitoxin has more than realised all expectations. The same, however, cannot be said in favour of tetanus antitoxin, as its curative powers have been found to be but feeble, and even massive doses, after the tetanic symptoms have commenced, have failed to bring about a cure in man. Anti-typhoid, and anti-cholera sera possess the property of killing the living bacteria and of dissolving them (bactericidal or lysogenic action) but they are not able to neutralise the poisons generated by the bacteria, and therefore are not antitoxic sera. As despite the most varied attempts in their preparation, bactericidal sera have not hitherto

* *The Practitioner*, December 1900 and May 1901. *The Lancet*, March 23rd, 1901.

shown any good results, experimenters have been thrown back on their old resources, *viz.*, the creation of an active immunity in the system, against the specific poison, as in cholera, typhoid, and plague, (Haffkine's Anti-cholera Inoculation, Wrights' Anti-typhoid Immunisation and Haffkine's Plague Prophylactic).

3. The reason why serum treatment has not been so satisfactory in the latter diseases is that they differ essentially in their nature from diphtheria and tetanus, which are *intoxication diseases*, in which the bacteria remain *in situ*, at the point of inoculation, the symptoms being almost exclusively due to the action of a toxine excreted by the microbe as a sort of metabolic product. Such however is not the case in affections like influenza, typhoid, plague, cholera, &c., because the specific poisons of these bacilli are not excreted by them, but are retained in the protoplasm forming the substance of the microbes—in some cases in the living protoplasm. These endo-protoplasmic poisons are named "Proteins." And curative properties can only be expected if the anti-bodies or immune bodies (in the sera) are capable of destroying the infecting bacteria, whether living or dead.

4. The researches of Pfeiffer on cholera vibrios have elucidated many important points in connection with sero-therapy and the experiment called "Pfeiffer's Phenomenon" has now become classical in bacteriological literature. He found that if active cholera vibrios were introduced into the peritoneal cavity of a guinea-pig actively immunised against cholera, they rapidly lost their mobility and disappeared entirely: if the same procedure were adopted in a normal (unprotected) animal, they multiplied and caused death. If the serum of the immunised animal is mixed with a certain quantity of active cholera vibrios and introduced into the peritoneal cavity of a normal animal, the solution of the vibrios (bacteriolysis, lysogenesis) also ensues. But it appears that such action does not go on indefinitely, and is limited, *e. g.*, if .001cc. of a typhoid immune serum is capable of protecting a guinea-pig against 2 milligrammes of a living typhoid culture, three times as much serum (.003 cc.) will not protect against 6 milligrammes of culture.

A certain dose of culture having been reached, it is of no consequence whatsoever how much serum is given—the result is the death of the animal. It is apparently these extraordinary phenomena which explain why it is that even with very high grade anti-typhoid sera, successful curative results have not been obtained in man.

5. In the elucidation of these phenomena, a number of investigators have been engaged. Metchnikoff says that the bacteriolysis of cholera vibrios is possible *in vitro* if to the cholera immune serum, a few drops of the normal peritoneal fluid of a guinea-pig be added. Bordet showed that the immune serum *by itself* will produce Pfeiffer's Phenomenon *in vitro* if perfectly fresh, and that it becomes inactive if allowed to stand for a short time, but that it can be activated by the addition of a small quantity of normal serum.

Pfeiffer himself explains the phenomenon thus. His theory is that the serum contains an immunising substance, immune body—anti-body, “substance sensibilisatrice” of Bordet, which possesses only slight inhibiting properties on the cholera vibrio, and that bacteriolysis is produced by its combining with certain substances normally present in the peritoneum of the immune animals. The animal elaborates these substances in an inactive but stable form, but in certain cases they are rendered active by the agency of the cells of the body. As normal serum is also capable of converting the inactive into active form, it is presumed that it must also contain a something in very minute quantity. Inside the body of the animal this something is reproduced, whereas *in vitro* it is rapidly used up and bacteriolysis cannot be brought about unless peritoneal fluid or normal serum is added. The substance is probably of the nature of a ferment, and its action appears to be selective as in this case it acts upon the proteplasm of the cholera vibrio.

6. The experiments of Pfeiffer, Metchnikoff and Bordet explain why the blood serum of an animal actively immunised against cholera is *insufficient or unable to cure a human being* for example, and the same argument applies to typhoid, plague, etc. In such a serum we have only a part of what we want, and the desideratum is the addition of the ferment like labile body—the “addiment” or “complement” of Ehrlich and Morgenroth, “alexines” (Buchner) which will induce the condition of bacteriolysis and destruction of the given infective agent. Wassermann experimenting with cultures of bacillus typhosus has shown that in order to increase the healing properties of a bactericidal serum one must add not only a “complement,” but one which is not destroyed in the animal body.

7. To what extent the complements “addiments” or “alexines” exist in the system and whether it is possible to increase their amount by artificial means are important questions bearing upon practical bacterio-therapy. Metchnikoff’s researches on phagocytosis confirmed and extended by Buchner show that the alexines are secreted by the phagocytes, and that it has been experimentally proved that even if the leucocytes be killed, the fluid containing the alexines is capable of bactericidal action.

And Dr. Bulloch has found from his own observations that artificial leucocytosis, brought about by the action of Sodium Cinnamate increased the amount of alexines. To what extent these complements or alexines increase or diminish under the influence of the poison of the plague bacillus, and whether they become constantly reproduced in sufficient quantities to combine with the immune body in the anti-plague serum are questions still awaiting investigation. It appears according to Wassermann that congenital immunity against infections, is to a large extent due to the defensive action of the complements or alexines. And whenever they have been specifically neutralised by an anti-body in experiments on animals, their congenital resistance is at once lowered, and a dose

that is sublethal under normal conditions, proves lethal. Wassermann thinks that attention should be paid to two questions:—First whether the amount of these complements can be increased, and secondly whether an easy and accurate method can be devised for the quantitative estimation of the specific complements. Dr. Bulloch's observation shows that the first is possible by inducing artificial leucocytosis, and attempts have been made by him and others to solve the second. Prof. Wright of Netley submitted* recently before the Pathological Society of London his observations on the *Bactericidal Action of Normal Blood*, and these have also an important bearing on the subject. He found that on plague bacilli the blood had no bactericidal power and similarly on staphylococci and streptococci. With typhoid and cholera bacilli the blood was very powerful, one 1 c.c. of blood would kill about 10,000,000 cholera bacilli, and after a dilution of about 20 the blood would still be able to kill off typhoid bacilli. Prof. Wright's observations therefore show what a difficult battle the system has to fight against plague infections of the blood and also against streptococcus infection which is by no means an infrequent concomitant of plague.

8. An interesting series of observations on the solutions (hæmolysis) of the red blood corpuscles has thrown considerable light on the action of immune sera and Bordet has been able to demonstrate that the laws which apply to the specific bacteriolytic action of immune sera also apply to the phenomenon of hæmolysis. He has found that just as the agglutinating properties of serum exist independently of its bacteriolysis powers, so also in hæmolysis where the agglutinative and hæmolytic powers are not identical and one may exist without the other. The researches of Ehrlich, Morgenroth and others now leave no doubt that the process of hæmolysis like that of bacteriolysis consists of 2 parts and depends upon 2 substances:—(1) a specifically active resistant body—the "immune body," and (2) a highly unstable body—the "addiment" or "complement."

9. In order to find out the laws which govern the behaviour of the immune body, and the complements in the presence of infecting bacteria, Ehrlich formulated a theory, called the "Side-Chain Theory" (Seitenkettentheorie) which has received experimental proof at the hands of Wassermann in the case of tetanus.

According to this theory the possibility of the formation of anti-bodies occurs if any body possesses the property of uniting with the side chains which Ehrlich considers to exist in the ultimate chemical structure of the proteid molecule. As Behring puts it "*that substance which when lying in a cell induces an intoxication, is the cause of the cure of the intoxication if it gets into the blood stream.*" If such a substance is soluble, *e. g.*, a toxine, a chemical neutralization takes place in the solution (serum). If the substance is not directly soluble (*e. g.*, a blood corpuscle, bacterial cell, etc.), it is

* The *Lancet*, March 23rd 1901.

not possible for the anti-bodies themselves to induce a solution or neutralization, but it can be experimentally shown that they become attached to the insoluble body, and the latter becomes ultimately dissolved by the subsequent action of the "complement." Ehrlich assumes that the immune body possesses a specific combining "haptophoric" complex and therefore must possess two points of attachments—one haptophoric group possessing great chemical affinity for the red corpuscle (or bacterial cell), the other haptophoric group possessing an affinity for the ferment like complement present in the blood serum. Under the influence of the two, the red-blood corpuscle is hæmolyzed, the immune body in virtue of its haptophoric complex becoming attached to the complement which is normally present in the blood stream. The complement thus becomes indirectly attached to the body (bacterial cell—red blood corpuscle or erythrocyte, etc.) for which the immune body has a specific affinity.

10. It is not known with certainty whether there is one complement or many. If the complement is a unity then there must be an infinite variety of immune bodies, the only thing common to them all being the possession of a definite haptophoric group for the complement. Ehrlich suggested that these side chains had different functions. They are relatively simple as when uniting with toxins which are probably simply excretory products of the bacteria. In the case of huge proteid molecules, like the blood corpuscle or bacterial protoplasm, the process must be more complex on account of a ferment being requisite for its breaking up, and hence two sets of haptophores are necessary, one to attach the poisons, and the other, the complement,—a ferment, which deconstitutes the complicated bacterial protoplasm and renders it inert. The complements are again thermostable or thermolabile depending upon their behaviour in the presence of heat. Von Dungern has, by further experiments, confirmed this Seitenketten-theorie of Ehrlich's.

It has been found that the "complement" of one animal has the property of giving rise in the body of another of an anti-complement, and this anti-complement if injected into the animal from which the complement had been derived, reduces the ability of that animal to deal with a disease which it could safely do under normal conditions, and thus a sublethal dose kills an animal, in which the normal complement had been antagonised.

11. Dr. Bulloch thus concludes his interesting article :—

"From the experiments and results which have been thus briefly summarised some idea may be obtained of the wonderful possibilities which have been opened up both theoretically and practically. With these experiments begins undoubtedly a new era in bacteriological science, an era which in all probability will lead to great events. Before, however, much practical advance can be made, it is certain that a vast amount of laborious laboratory work will have to be

done for the elucidation of the principles which underlie the destruction of foreign protoplasm introduced into the living body, before the knowledge can be elevated to the rank of practical therapeutic means. Already, however, the classical work of Bordet, Ehrlich, and Metchnikoff shows that there is a similarity in the method by which toxic cells are dealt with. In all cases as the result of injection, a specific anti-body is produced, insufficient in itself, however, to compass the destruction of the cell which called it into existence. In this discovery alone one can recognise a marked advance upon previous work, and one can realise why it is that sero-therapeutic results, apart from diphtheria and tetanus, have been so disappointing. Where protoplasm itself is toxic, its dissolution takes place by highly labile bodies (alexines, complements) present in the normal circulating blood, and without doubt it produced and reproduced through the agency of cells which are probably leucocytes. It may be that the alexines are also in the interior of such cells (phagocytes in Metchnikoff's sense). But even the alexines, if unaided, are powerless. The coalition, however, of the alexine and the immune body reacts on the toxic protoplasm and deprives it of its pathogenic effect. Whether in all cases the protoplasm leaves the body of the cells containing it, like the hæmoglobin of the erythrocytes, or whether it is destroyed *in situ* cannot yet be definitely stated. Whether even the process of hæmolysis is a vital process or a purely physical one depending on changes in the permeability of the erythrocytic wall through the agency of the alexine is still a matter of doubt. Still, so much has been done, and so much still remains, that the new field must for years be fruitful soil for workers, who are interested in the development of therapeutic means which may be of service in combating the possibilities and the effects of infection."

12. This then is the present position of sero-therapy and it explains why the success with Lustig's serum in the treatment of plague has not been so encouraging as anticipated, and why also the results obtained during the epidemic of 1900-01 have not been so gratifying as during previous year. There is, however, no cause to be discouraged, and it is only by further observation, experiments and research that it would be possible to perfect the serum treatment of plague, which has hitherto given results which are by no means to be despised, when we realize how high the normal mortality from the disease is. It is, therefore, absolutely necessary that further research and experiments should be directed towards the following on analogous lines :—

(a) The perfection of a serum of a very high grade—the highest possible attainable, according to our present knowledge and methods of work.

(b) An investigation with a view to find out, whether there is any increase or decrease of the alexines in the human or animal body under the influence of plague poison, and whether they are

being constantly reproduced under these conditions, and if not, whether there are any means of increasing their production, so that they may be able to keep up constant coalition with the immune body in the serum in order to effect bacteriolysis.

(c) An investigation to show whether it is necessary that any normal horse serum, should be added to the anti-plague serum, in order to increase its potency, by supplying some "complements," and if so, under what circumstances and in what proportions.

Unless an extended, and extensive series of observations have been made on the lines above indicated, no progress would be possible in the successful treatment of plague with Lustig's or any other serum, especially, now that we realise how complex are the processes that are involved in the process of bacteriolysis, and how difficult the problem that has to be solved in dealing with the successful treatment of plague by serum. It is to be hoped that the Municipal Corporation of Bombay would stint no efforts in encouraging the perfection of the only known means for the cure of a disease, for the prevention of which by Haffkine's Prophylactic, they had given such encouragement in the early days of its discovery. And it has to be borne in mind that no advance in soro-therapy is possible unless, and indeed, by long, patient, and laborious laboratory work, in conjunction with experiments on animals.

II.—THE EPIDEMIC OF 1900-1901.

13. In the report on serum treatment for January last, I had drawn attention to the increasing virulence of plague in the early days of the epidemic, and attempted to show how far the cases differed from those observed in the previous epidemic. These remarks were intended as a forecast, which became fully confirmed as the epidemic advanced. And now that the epidemic is practically over, a general review of the cases treated with and without serum would not be without interest.

14. The principal characteristics exhibited by the cases were the following :—

- (a) *Rapid extension of the local infection with multiple contiguous buboes.*
- (b) *Intense and rapid septicæmia.*
- (c) *Irregular course, prolonged duration, frequent relapses due to reinfection, or extension, indolent buboes remaining enlarged for a long time or suppurating very late and numerous complications.*
- (d) *Tardy convalescence, or marasmus from secondary infections, or death from plague pyæmia and consequent toxic degenerations of the internal organs.*
- (e) *Greater resistance to the action of serum.*

A detailed consideration of the above characters would explain the gravity and nature of the cases treated :—

(a) *Rapid extension of the local Infection with Multiple Contiguous buboes.*

15. This was perhaps the most noticeable feature observed. Whereas in previous epidemics, multiple buboes (distal and contiguous) existed in a comparatively small proportion, about 13·95 per cent (as shown by an analysis of 9,500 cases of the bubonic type), the ratio became greatly increased, and the proportion in which they existed in only 411 cases was 63·01 per cent. In this connection, I made the following remarks in my report for January 1901 :—

“It is not implied from the above that such cases did not exist in the previous epidemics. All that is contended here is that, whereas in former epidemics they were fewer in number, and were observed during the height of the epidemic only, they have appeared now in larger numbers—in fact constitute the bulk of the admissions—and at the beginning of the present epidemic.”

This statement was confirmed as the epidemic advanced, and multiple buboes did eventually form the bulk of admissions by attaining the unprecedented proportion of 63 cases out of every 100, and *pari passu* the ratios of single buboes declined. Single axillary buboes that prevailed to the extent of 21·85 per cent. in former epidemics, showed a rate of 17·77 per cent. and single buboes in other positions (femoral, inguinal, cervical, parotid, &c.) dwindled down from 65·20 per cent. to 14·11 per cent. Pneumonic plague had a ratio of only 2·44 per cent. against 4·10 per cent. and plague *without apparent buboes* a ratio of 2·67 per cent. against 14·25 in previous epidemics. It is apparent from the above that the normal proportions of the different clinical varieties of plague showed a marked divergence from what existed in the four previous epidemics, and the multiplicity of buboes increased the virulence of the disease by multiplying the foci of systemic infection and consequent general toxæmia.

16. Triple buboes in the groin—femoral, inguinal and iliac—were a constant and by far the most predominant feature and on *post-mortem* examination it was found that almost invariably the deep iliac, lumbar, and retro-peritoneal glands were infected, on the same side and often and often the infection was found to have travelled over to the opposite side of the body. The mesenteric glands became also infected secondarily, and so also the deep femoral, and popliteal. It may be mentioned here that distal multiple buboes (*i. e.*, buboes far removed from each other and in different parts of the body) which result from secondary infection in plague septicæmia of a mild type are not so fatal, as contiguous buboes like the femoral, inguinal, iliac, deep iliac and lumbar, that so often form a chain extending from the Scarpa's triangle almost

up to the diaphragm. The former appear somewhat late in the course of the affection, and at times after the most acute symptoms have subsided, whereas the latter begin with the beginning of the disease, and the "trinity" may be observed within a few hours of the onset of the symptoms. And again in apparently mild cases that had proved fatal and had shown scarcely any external signs, *post-mortem* examination revealed deep-seated buboes in unusual positions; *e. g.*, in two or three cases, a large bubo, hæmorrhagic and infiltrated was found wedged in perpendicularly in the connective tissue between the wall of the bladder, and the pelvic bones. Sometimes the faintest trace of swelling or infiltration in the neck or axilla would be noticed after a most careful examination during life, and yet on *post-mortem* examination numerous and deep-seated buboes would be found. And as many as 20 to 30 tiny buboes have been removed from the deep cellular tissue of the axilla, in a case, where during life the only visible sign of plague was a faint and painless infiltration. In most of these cases where the buboes that had been removed were small and almost imperceptible, rapid and intense septicæmia existed. And cases which were apparently mild and showed only a single bubo externally, revealed similarly after death deep and unsuspected infection. Another curious feature revealed on *post-mortem* examination in 2 female patients was the following:—Both had triple buboes in the groin, and on *post-mortem* examination about 50 to 60 small suppurating buboes were found over the adipose tissue and between it and the subcutaneous cellular tissue. All these contained pus, and plague bacilli and were probably secondarily infected; cutting deeper, the original buboes were observed encapsuled in a bag of pus, partly necrosed, and partly infiltrated with hæmorrhage.

17. The subjoined table gives an analysis of the cases and their rate of mortality. Multiple buboes had a mortality rate of 79·53 per cent., single axillary buboes 76·71 per cent., single buboes in other situations 50·00 per cent., pneumonic plague 100·00 per cent. and plague without apparent buboes 100·00 per cent. The total mortality rate in 411 cases was 75·91 per cent. The only redeeming feature in these figures is the comparatively low mortality in single buboes other than axillary, because of the fact that all these cases were non-septicæmic on admission, and some of them were extremely mild:—

1901.	Multiple Buboes.			Single Axillary Buboes.			Single Buboes in other Positions.			Pneumonic Plague.			Plague without Apparent Buboes.			Total.		
	No.	Died.	Recovered.	No.	Died.	Recovered.	No.	Died.	Recovered.	No.	Died.	Recovered.	No.	Died.	Recovered.	No.	Died.	Recovered.
January	32	21	11	6	4	2	9	6	3	1	1	...	...	...	...	48	32	16
February	81	64	17	27	18	9	20	13	7	1	1	...	3	3	...	132	99	33
March	95	78	17	24	22	2	13	6	7	4	4	...	5	5	...	141	115	26
April	40	33	7	15	11	4	13	3	10	3	3	...	2	2	...	73	52	21
May	11	10	1	1	1	...	3	1	2	1	1	...	1	1	...	17	14	3
Total.	259	206	53	73	56	17	58	29	29	10	10	...	11	11	...	411	312	99

(b). Intense and Rapid Septicæmia.

18. Systematic examination of the blood both by the microscope and but more specially by culture (greater reliance having been placed on the latter) confirmed the idea entertained in my report of January last that blood septicæmia was the cause of the intense gravity and virulence of the cases. In all the cases admitted during February, March, April, and May, blood was examined at the time of admission, but unfortunately on account of pressure of work the examination could not be kept up from day to day. Cultures showed that 45 per cent. of cases were already septicæmic at the time of admission and that out of 165 such septicæmic cases there were only 4 recoveries, is sufficient to show their gravity. As to the extent of the septicæmia, it varied very greatly, and the colonies were divided for purposes of comparison into 3 classes—few, numerous, and innumerable. In the two latter, death was very rapid, in the former it was somewhat late.

19. Of the cases that became septicæmic *after* admission, no observations could be separately recorded; in some instances blood was examined from time to time and generally confirmed the clinical inference that septicæmia had set in, whilst in others, the appearance of secondary buboes in other parts of body or secondary pneumonia, left no doubt as to the state of the patient. It is probable that the proportion of septicæmic cases was greater, but could not be detected on account of the small quantity of blood examined. It is absolutely necessary, says Dr. Symes,* that at least 2 cubic centimetres of blood should be taken from a vein for examination for blood infection. This was not possible in our cases, firstly from the difficulty of fixing the veins in dark skins, on account of sluggish circulation, and secondly from want of time. We had to content ourselves with making cultures from 2 or 3 drops of blood taken, after proper precautions, from finger tips, and with the results above stated. Had the direction given by Dr. Symes been followed, the results would have been still more significant. He says that failure to detect micro-organisms cannot be accepted as a proof of their absence for the quantity of material is relatively small. And as this refers to 2 cc, it is obvious that with 2 or 3 drops of blood, the results would be still less satisfactory. The bacteriology of plague is further complicated by secondary infections—streptococcus and staphylococcus—and at times plague bacilli as well as cocci are found in cultures. At other times, in most undoubted cases of plague, examination of blood some time prior to death reveals cocci only, but no plague bacilli. I am greatly indebted to Dr. N. Berestneff, of the University of Moscow (late Russian Sanitary Delegate at Bombay) and to Dr. Alfons Mayr of the Municipal Laboratory for their cordial co-operation in making blood examinations, but for whose aid, it would not have been possible to examine so many cases systematically.

* The Margin of Error in Bacteriological Diagnosis—By Dr. J. Odery Symes: British Medical Journal, February 23rd, 1901.

(c). *Irregular Course ; Prolonged Duration, Frequent Relapses due to reinfection or extension ; Indolent Buboës, remaining enlarged for a long time or suppurating very late and Numerous Complications.*

20. (i). *Irregular Course, Prolonged Duration, and Frequent Relapses :—*

These three may be considered together. On account of the multiplicity of buboes, and extension of the infection, the normal temperature curve of plague was found to be greatly altered, and even in cases where the extension was within moderate limits, the temperature did not reach to normal till the thirteenth or fifteenth day. Irregularities in the temperature curve were due to infection of new glands, and at each fresh infection, the thermometer gave a clear, and unmistakeable indication, although there may have been scarcely any external signs. Secondary, and tertiary buboes appeared at long intervals, and kept up the patient's temperature, and at the same time sapped his strength. It was contended by some, that some of these late buboes were not due to infection by the plague microbes, but were the result of toxæmia, but this was not borne out by investigation. Under these circumstances, the course of the disease became very irregular, and prolonged, and whereas in former epidemics a patient was considered practically safe if he passed over the tenth day of illness, there was no limit in this epidemic, and although life was prolonged from day to day, especially under the serum treatment, it was almost impossible to declare a patient convalescent within a definite period, and patients have survived in hospital for more than eight weeks, without there being any hope of their ultimate recovery. Temporary improvements in the condition of the patient were extremely delusive, and no favourable prognosis could be given for a long long time.

21. (ii). *Indolent Buboës, and Late Suppuration.*—This was marked specially in the case of iliac buboes. They varied in size from a pigeon's egg to a cricket ball and would neither resolve, nor suppurate for long periods. Symptoms would occasionally point to localised peritonitis around them, and if resolution did come about eventually it was extremely slow, and would take weeks, and if the patient exerted himself in any way or tried to walk, when in this stage, acute or subacute symptoms would appear, causing pain, tension and tenderness, and again confining him to absolute rest in bed. When they suppurated, they had to be incised through the walls of the abdomen and drained. Such buboes have been opened as late as on the 48th day of illness,* and the pus has been found to contain plague bacilli, in an active state and capable of growth by cultures. In another case, the bubo was opened on the 27th day of illness, and although plague bacilli were absent in the pus only a few cocci being found, the blood of the patient gave distinct

* In two instances.

agglutination. The former cases give rise to a question which has long been debated, viz :— *Whether a plague patient could himself be free from all acute signs of plague and yet be capable of infecting others and if so upto what period ?*

In the light of the above cases and others, where the suppurated buboes seem to remain encapsuled, and dormant for a long time, it must be assumed, that although the patient himself remains immune, the encapsuled bubo containing plague bacilli is capable of infecting others if it bursts of itself or is opened, and that the period of infection may be as late as 50 days after the initial attack of the disease. And perhaps in this condition the patient himself is not free from the risk of auto-infection, if through any cause his standard of immunity becomes lowered, and the plague bacilli gain an entrance into his system from such a focus.

22. (iii). *Complications.*—The extent and severity of the complications bore no relation to what was observed in the previous epidemics. They existed in greater frequency, were graver in their import and contributed greatly to the heavy mortality. Often and often more than one serious complication co-existed in the same patient, and carried him off. Amongst those more frequent were coffee-ground vomiting, meningitis, secondary pneumonia, secondary infections and marasmus. No note has been taken here of the minor complications like delirium, aphasia, paralysis of the extensors from peripheral neuritis, bulbar paralysis, ascending and descending lymphangitis and lymphadenitis, etc., which, although not necessarily fatal, retarded the progress of the cases.

The following statement gives an approximate idea of the nature of the graver complications and their fatality in the 411 cases admitted from January to May 1901 :—

Complications.	No.	Died.	Recovered.
Coffee-ground Vomiting	25	24	1
Meningitis	19	18	1
Secondary Pneumonia	28	24	4
Hæmaturia	2	2	.....
Secondary Infections	9	5	4*
Do. + Marasmus	9	6	3
General Convulsions	2	2	.....
Tympanites	8	7	1
Peritonitis	3	2	1

* These were cases of extremely mild secondary infections with only a few colonies of occi in the blood and had single buboes.

(d). *Tardy Convalescence, or Marasmus from Secondary Infection, or Death from Plague Pyæmia and Consequent Toxic Degeneration of the Internal Organs.*

23. In one of the preceding sections, the causes of the prolonged and irregular course of the disease have been discussed, and the same causes operated in those patients who became convalescent, to retard their recovery. Either fresh complications in the shape of new buboes developed, or secondary infections—streptococcus or staphylococcus—brought them again on the verge of death. After the patients had gone on to a certain hopeful stage, they suddenly retrograded, and marasmus set in, accompanied by prostration, and break-down of the nervous system, rapid, and great wasting, enfeeblement of mental faculties, localised paralysis or bulbar paralysis, inability to swallow food, etc., in fact the patient who looked bright and cheerful and on the high road to recovery, became a physical and mental wreck. This was generally found to be due to intense toxæmia or secondary infections and only a third of the patients that got into this state could be brought round with extreme difficulty—especially as no help from them was forthcoming to hasten their recovery—and eventually two of them were discharged in a fairly satisfactory condition after having been in hospital nearly 4 months, and one is now almost well.

24. In other cases, although life was considerably prolonged, death eventually supervened, and it was found to be due to plague pyæmia, and toxic degeneration of the internal organs. Hardly any organ was free from degeneration, parenchymatous, adipose or amyloid and infection and suppuration of almost the whole lymphatic system was evident. On *post-mortem* examination, however, no plague bacilli could be found in one of these late cases, and all that was observed was the degeneration.

(e) *Greater Resistance to the Action of Serum.*

26. In the report for January 1901, above quoted, reference was made to the larger doses of serum needed, the average having been 400 cc. in the cases that recovered, during that month. As the epidemic progressed, it was found that even 400 cc. had but temporary effect, and it was considered advisable to make further observations with a view to determine whether large doses would have the desired effect, and the limit to which the serum could be safely pushed. The doses were accordingly increased and the limit to which the serum could be pushed determined. But it will be noted from what has preceded in this report, how hopeless was the struggle against such rapid and intense septicæmia and an infection of this extensive nature and the results fully justify the conclusion, that however strong the serum, there is a limit to its efficacy, and if the infection goes beyond a certain stage, there is no possibility of cure. There is no doubt that often and often life was prolonged by the serum, by controlling to a great extent the septicæmia and

also the extension of local infection, but art was unable to overtake nature, and had to step aside, letting nature take her own inevitable course. The experiments and conclusions related in the first section of this report explain why even with such massive doses of the serum it was impossible to save life in the majority of cases and the two desiderata laid down above, *viz*:—that enormous doses of even high grade sera fail in cholera, typhoid, and plague, because there is a limit to their action on account of the peculiar nature of the intraprotoplasmic poison, and that in these sera we do not possess *all* the means that are necessary to neutralise the effects of these poisons, have been confirmed by the results of the serum treatment during the epidemic of 1900-01.

27. However gratifying were the results obtained on the alternate system during the epidemic of 1899-1900, the same cannot be said of the last epidemic, and this itself shows that there must be, as there actually are, limitations to the use of serum in plague, and that in cases where septicæmia had already set in before the treatment was begun or where a multiplicity of buboes existed, it was almost a hopeless struggle against fate, and no amount of serum, could save the patient, although it was capable of prolonging life, and ameliorating symptoms. Nothing could illustrate this better than a short synopsis of the 19 cases, each of whom received over 1000 cc. of serum. Fourteen of them died and five only recovered and as we were enabled to make *post-mortem* examinations on some of them, considerable light has been thrown upon the nature of these cases and the extent of the infection (local and general) in them.*

28. *Case No. 503.*—The patient, a Hindu boy, aged 15, came under treatment on the 5th day of illness (March 14th 1901), with right axillary infiltration. The quantity of serum injected morning and evening day after day has been marked on the accompanying chart. After some temporary improvement he developed secondary buboes (double femoral, inguinal and iliac) on March 17th; secondary pneumonia appeared on the 23rd *idem*, and on the 30th, left parotid and iliac buboes were observed. From the 25th of March to the 10th of April he was in the marasmatic condition above described, and his life was despaired of. So long as there was any indication of fresh infection, the serum injections were kept up and within 20 days, the total quantity injected subcutaneously was 1580 cc. The patient eventually made a good recovery, and was discharged from the hospital 2 months and 4 days after admission.

29. *Case No. 516.*—This patient was a sweeper, aged 30, and was admitted on the third day (March 12th, 1901) of illness with left femoral, inguinal and iliac buboes. On the 13th, he developed right femoral: on the 15th, right iliac, on the 22nd, secondary pneumonia, and on the 29th, left femoral and iliac buboes appeared to be soft and suppurating. The left femoral bubo was incised on the 6th of

* The temperature charts of these cases have been appended to this report, together with the usual tables giving the details of the cases treated with the serum.

April, but the iliac became again hard, and remained indolent and enlarged but painless till the 29th following; it then became gradually smaller, and when the patient was discharged on the 5th of May it had shrunk considerably, but could still be felt. This patient received the enormous amount of 2405 cc. of serum—all subcutaneously, within 20 days, and he had to be kept so long under its influence, as there were distinct signs of deep abdominal infection, and so long as they persisted it was not deemed advisable to stop the serum. All the other buboes resolved. The largest quantity of serum injected on a single day was 400 cc. in 4 injections of 100cc. each at intervals of 4 hours, the day after his admission.

30. *Case No. 654.*—The patient, a Hindu female famine emigrant, was admitted on March 27th with left femoral, inguinal, and iliac buboes. She received within seven days 1150 cc. of the serum subcutaneously, the buboes resolved, and she was discharged cured on the 5th of May. In this case plague and malaria were combined, and as soon as the acute plague symptoms subsided, there was elevation of temperature. Anticipating some extension of infection, the serum was continued four days longer, but as there was total absence of all local signs, and the patient's condition no worse, except for the evening rise, malaria was suspected, and she was put upon quinine; the effects of this were soon apparent, the fever became less, and eventually subsided altogether.

31. *Case No. 677.*—A Hindu male, aged 25, admitted on the 5th day of illness (March 31st, 1901) with a large bubo in the right iliac fossa, and small femoral, and inguinal buboes on the same side, together with cellule-cutaneous necrosis (about 3" in diameter) on the loin. There was localised peritonitis in the right iliac fossa, the day following, and he developed secondary pneumonia on 2nd April. The total quantity of serum injected was 1880 cc. within 12 days. On April 14th he developed an abscess on the back of the thigh at its upper third, and when it was opened on the 20th, it was found to discharge very offensive pus, and communicating with the hip joint; the bone was denuded of periosteum and exposed. This did not completely heal up till the end of June. The iliac bube remained as a large hard mass of the size of a cricket ball till the end of the month. It became soft thereafter and was eventually opened on the 48th day of illness; the pus was found to contain plague bacilli capable of growth. The convalescence of the patient has been very tardy and he is still in hospital on the 30th of June. The necrosis separated, and was removed and the ulcer healed up rapidly. This patient remained for 3 weeks in marasmus.

32. *Case No. 805.*—The patient, a Purdeshoe syce, was admitted on the 6th(?) day of illness with right femoral, inguinal, and iliac buboes, and a pimple over the hypogastrium, he developed secondary pneumonia on the 4th day after admission. The total quantity of serum injected subcutaneously was 1020 cc. within 11 days. All the buboes resolved, and he was discharged cured on the 25th of May.*

* All of these cases were not septicæmic on admission.

33. *Case No. 182.*—The patient, a Hindu male, aged 25 years, was admitted on the 3rd day of illness (29th January 1901) with left inguinal and iliac buboes. He was placed under Roux's serum and received 900 cc. in four days, but as the quantity of this serum became exhausted, it was supplemented by 600 cc. of Lustig's serum within the four days following—the total quantity injected thus came to 1500 cc. The buboes became large, hard and infiltrated, and the whole of the Scarpa's triangle and iliac fossa appeared to be filled by a hard stony mass. Some fluctuation having been felt, the inguinal bubo was incised, but with temporary relief; the patient got steadily worse, and died on the 10th of February. *Post-mortem* examination was made by Dr. Dürk of the University of Munich, and the deep iliac, lumbar and abdominal glands were found to be infected: there was a thrombus in the left femoral vein, and multiple embolic abscesses, containing plague bacilli, were found in the liver and both the lungs.

34. *Case No. 467.*—The patient, a Hindu male, aged 25, was admitted on the second day of illness (March 4th) with left axillary bubo with infiltration. He was not septicæmic on admission. After receiving 470 cc. of the serum within 3 days, he improved so much, that the serum was stopped and he was considered semi-convalescent. He remained in this condition for 5 days and then relapsed on the 12th; he developed double femoral, inguinal, and iliac buboes; on the 16th, right posterior cervical with infiltration; on the 17th, infiltration on the abdominal wall, side of the thorax; on the 20th, secondary pneumonia and on the 24th, he sank into marasmus. When the secondary buboes developed, the serum was resumed and he had 675 cc. more during six days. He died from secondary infection, on the 34th day of illness, the temperature rising to $108^{\circ}4$ a few hours before death. *Post-mortem* examination was made by Dr. Berestneff of the University of Moscow and death was found to be due to marasmus from secondary infections: fatty degeneration of the heart, and liver, oedema of the lungs, hypostasis, bronchitis and hydrothorax were also noticed. No traces of plague bacilli could be found anywhere.

35. *Case No. 471.*—The patient, a Mussalman female, aged about 20, was admitted on March 5th on the second day of illness with left inguinal bubo: she was septicæmic; she had a miscarriage the same morning at 1 a.m. She had 10 injections of serum within five days, amounting to 1070 cc., 100 cc. of which was given intravenously on three occasions, in doses of 30, 30, and 40 cc. She died of heart failure on the fifth day after admission. No *post-mortem* could be made.

36. *Case No. 478.*—The patient, a Hindu female, aged about 20, was admitted on the 5th (?) day of illness with left axillary bubo. She was non-septicæmic on admission; she received in all 1160 cc.

of serum in eleven injections, but in spite of this, she developed a secondary bubo (left femoral) five days after admission. She died of heart failure on the eighth day after admission.

37. *Case No. 572.*—The patient, a Christian convert child, aged about 11, was admitted on the fourth day of illness (18th March) with left femoral, inguinal and iliac buboes. She was not septicæmic on admission. She had coffee-ground vomiting on the day of admission; on the 20th, right femoral, inguinal and iliac buboes developed, on the 22nd, she had general convulsions and the temperature rose to $107^{\circ}\cdot8$, and on the 26th she sank into marasmus, and died in the same condition on the 1st of April, on the 15th day after admission. She had altogether 1090 cc. of serum in 23 injections.

38. *Case No. 588.*—The patient, a Native Christian girl, aged about 15, was admitted on the 2nd day of illness (18th March) with right axillary bubo; she was septicæmic on admission and innumerable colonies of plague bacilli were found on culture. Within four days, she had received 450 cc. of serum, and had so far improved that the dose of serum was reduced. This was, however, followed by a relapse, for on the evening of the same day, she developed double femoral buboes, the iliac appeared on the 25th and left axillary the day following. From the 29th she sank into marasmus, and died ultimately on the 24th day of illness, with hyperpyrexia, from some secondary infection, the temperature reaching to 109° . The total quantity of serum received by her was 2205 cc. in 24 injections.

39. *Case No. 613.*—The patient, a Hindu female, aged about 30, was admitted on the third day of illness (22nd March), with right femoral, inguinal and iliac buboes. She was septicæmic on admission. On the day following, she had coffee-ground vomiting, and on the 24th, intense tympanites set in. After it was relieved by appropriate treatment, the patient improved very greatly, but it appeared as if the deeper glands were getting infected. The serum was kept up, and she received 2150 cc. in all in 21 injections. On the first day she had 400 cc. in four injections of 100 cc. each at intervals of four hours. She died from heart failure eleven days after admission. On *post-mortem* examination, femoral, inguinal, iliac, lumbar and mesenteric buboes were found suppurated. Multiple abscesses and emboli in the lungs, fatty degeneration of the myocardium and liver, &c., were noticed.

40. *Case No. 644.*—A Mahomedan, aged about 23, was admitted on the fifth day of illness, with left femoral, inguinal and iliac buboes. The patient was not septicæmic. He had in all 1150 cc. of serum in nine injections, 160 of which were given intravenously on four occasions in doses of 40 cc. each, but he developed secondary pneumonia, and died on the fifth day after admission.

41. *Case No. 685.*—The patient, a Hindu female, aged about 25, was admitted on the second day of illness with left axillary bubo. She was not septicæmic; she received in all 2070 cc. of serum in 19

injections, 600 cc. having been injected on the first day in doses of 150 cc. each at intervals of 3 to 4 hours. She did not develop any evident secondary buboes, and repeated examination of blood failed to show plague bacilli; she succumbed on the thirteenth day after admission. On *post-mortem* examination the following was noticed:—atelectasis pulmonum; bronchitis; old pleuritic adhesions; acute degeneration of the heart muscle; parenchymatous nephritis, melanosis in spleen; lymphatic abscesses in the axilla, on the right side, and hæmorrhagic buboes—inguinal and femoral—thrombus in the right saphena vein, subcutaneous hæmorrhage in the skin of the leg, and œdema of the right lower extremity, etc.

42. *Case No. 759.*—The patient, a Hindu male, aged 20, was admitted on the third day of illness (11th April) with right axillary bubo and infiltration. He was septicæmic. On the 16th right femoral, inguinal, and iliac buboes appeared, and similarly on the 22nd those on the opposite side. The patient received 2000 cc. of serum in 19 days, but died ultimately from secondary streptococcus septicæmia.

43. *Case No. 806.*—The patient, a Hindu female, aged about 20, was admitted on (?) day of illness (18th April). She was not septicæmic, and had left axillary and right pectoral buboes: secondary pneumonia developed on the 23rd, and the patient died on the eighth day after admission. She received in all 1420 cc. in nine days.

44. *Case No. 799.*—The patient, a Hindu male, aged 20, was admitted on the 4th day of illness (18th April) with double axillary buboes. He was septicæmic and had double blood infection—plague and staphylococcus. He received 1260 cc. of serum in 13 days; on the 21st, he developed secondary pneumonia and on the 27th, left femoral and iliac buboes. He died on the 17th day after admission.

45. *Case No. 829.*—The patient, a Hindu male, aged about 20, was admitted on the third day of illness (20th April) with double axillary and double femoral and inguinal buboes. Though clinically septicæmic, plague bacilli were not found in the blood. Secondary pneumonia developed on the 21st, and then infiltration on the right and left sides of the neck on the 27th and 28th respectively. He received 2280 cc. of serum in 21 days, and died on the 22nd day after admission. On *post-mortem* examination the following was noticed:—General lymphatic infection with abscesses, degeneration of heart, and liver, extensive hæmorrhage from the pelvis of the kidney and parenchymatous nephritis.

46. *Case No. 853.*—A Hindu child, aged 6, supposed to be ill for 10 days, was admitted on April 25th with a primary blister over the shoulder, left axillary, double femoral and right inguinal and iliac buboes. She was septicæmic and double blood infection was present—plague and streptococcus. She had 1300 cc. of serum in 16 days and died on the 19th day of illness.

47. On comparing the course of events and *post-mortem* appearances in the non-serum cases with the above, no striking differences could be observed, and a few random selections from them repeat almost the same tale.

Case No. 419.—Death on the fourth day. *Post-mortem* appearances : atrophy of myocardium, œdema of lungs, amyloid degeneration of kidneys.

Case No. 323.—Death on the third day. *Post-mortem* appearances : pneumonia, atelectasis pulmonum, multiple abscesses in liver, parenchymatous, and hæmorrhagic nephritis, fatty degeneration of myocardium.

Case No. 362.—*Pestis hæmorrhagica* : almost universal hæmorrhage in all the organs.

Case No. 463.—Death on the thirty-eighth day : abscesses, femoral, iliac and lumbar, degeneration of organs : subcutaneous abscess in the thyroid region.

Case No. 785.—Embolic abscesses in lungs, kidneys and in pancreas, general icteric condition of organs and tissues.

Case No. 776.—Multiple hæmorrhagic polyadenitis : degeneration of organs : profuse hæmorrhage from pelvis of kidney (in the sub-peritoneal cellular tissue).

48. The total number of *post-mortem* examinations made during February, March and April was 38, of which 15 were made by Privat-Docent, Dr. M. Dürk of the University of Munich : 20 by Privat-Docent Dr. Nicolas Berestneff of the University of Moscow, and 3, by Dr. A. Mayr of the Municipal Laboratory, to all of whom I take this opportunity of tendering my best acknowledgments for their cordial co-operation and assistance. It is obvious from the foregoing, how essential these examinations were, and in their absence, much that has been learnt during the last epidemic would have been left in the dark.

49. The chief and essential difference between the cases treated with and without the serum was the undoubted prolongation of life, and comparatively fewer cases died at such a late stage of illness amongst the latter. There was a marked difference even in the deaths that took place within 48 hours of admission, the non-serum cases losing many more than the serum. So that in both directions, there was ample evidence of prolongation of life.

50. The reason why there was greater resistance to the action of serum is therefore quite apparent from what has been stated above, and in the presence of the multiplicity of the foci of systemic infection must be traced the origin of the same. Time after time plague bacilli were found to disappear from the blood, both after intravenous and subcutaneous injections, but they again almost invariably appeared. Intravenous injections had a more decided effect and after every injection there was a fall of temperature, and improvement in the condition of the patient. But it was not

possible to continue intravenous injections indefinitely, and in no case was it possible to give more than two injections within twenty-four hours. The difficulties connected with this method were very great; the dark colour of the skin combined with a weak and almost failing circulation, made it no easy task to fix a vein, and sometimes after repeated efforts, the attempt had to be given up. In fact, the latter was a great bar to anything like an extensive use of this method of treatment. Its effects were, however, well marked in some cases and as an instance case No. 133 may be quoted:—The patient, a Christian girl, aged about 13, was admitted on the second day of illness with right femoral and inguinal buboes. The temperature on admission was $101^{\circ}\cdot4$; at about 10 a.m. she was given 40 cc. of serum intravenously, and soon after 60 cc. subcutaneously. Within half an hour she had a rigor and temperature rose at once to $106^{\circ}\cdot4$. This was due probably to the serum having not been sufficiently warmed before injecting intravenously. The temperature did not remain high very long, the patient commenced to perspire freely within a short time and it fell to $101^{\circ}\cdot6$ by 2 p. m.* In the evening it was $100^{\circ}\cdot2$ and the following morning $97^{\circ}\cdot4$. She received 50 cc. and 30 cc. subcutaneously, on the two days following, but it appeared that there was no necessity for the second injection. Both the buboes had almost disappeared within 24 hours of the intravenous injection: there was no pain or swelling, and except a slight rise of temperature on the evening of the second day, she was convalescent. The patient made an uninterrupted recovery. And similarly in cases that eventually proved fatal, both intravenous and subcutaneous injections showed a marked influence on the condition of the patient, and especially as regards buboes, which became smaller, hard, and less painful. †

51. Another point that was noticeable as regards the action of serum was this:—It was found that although the effect of the serum on blood infection was marked, re-infection took place so often, and so rapidly, that unless a constant stream of serum was kept up, there was no possibility of counteracting the re-infection, and as the channels of infection were multiple, and their connection with the venous and arterial systems intimate, it is not difficult to realise how futile were the efforts to keep it under check. Dr. Leaf has described how direct connection exists between the lymphatic vessels and veins, and even in some cases arteries, especially in the thoracic region, axilla, and groin. Such being the case direct blood infection would be extremely easy with multiple infection of lymphatic glands. And the frequent association of septicæmia and secondary pneumonia with axillary buboes, leading to the high rate of mortality in them is readily explained by such direct connection between the lymphatic vessels of the axilla and the veins in the same region.

* This crisis has also been observed in other cases without rise of temperature, profuse perspiration, frequent sneezing with a thin watery discharge from the nose, profuse lachrymation.

† The average quantity of serum injected intravenously at one time was 40 cc.; in some cases however 60 to 80 to 100 cc. even were injected.

A similar connection has been shown to exist in the femoral and inguinal regions. Dr. Leaf's observations have led him to formulate the following conclusions * :—

1. The azygos veins normally receive a great many lymphatic vessels.
2. Some of the smaller arteries in the thoracic region open directly into lymphatic vessels: some of the smaller veins open directly into large lymphatic trunks, and these two factors help to quicken the movements of the lymph.
3. Direct communications are found to exist between arteries, lymphatic vessels and veins.
4. The communications between veins and lymphatic vessels have been observed to take place in a great many regions in the body (the vena cava, the portal, the renal, axillary, internal iliac and the azygos veins,—all directly communicate with the lymphatic system).
5. Owing to the presence of these communications, the cells of a malignant growth (and the plague bacilli as well—N. H. C.) can pass either from the lymphatics into the veins or *vice versa*, and hence not only in the sarcomata but also in the carcinomata the cells as well as the lymphatics should always be regarded as channels along which the cells may at any moment be conveyed to distant parts of the body.

It is sufficiently clear from the above how constant infection and re-infection of blood is possible with multiple infection of lymphatic glands, and how difficult, nay almost impossible it would be to keep the blood stream constantly charged with enough serum to bring about bacteriolysis. And thus Dr. Leaf's important contribution helps us to understand how with even massive doses of sera it was not possible to overtake the rapid and recurring septicæmia of plague.

52. And again, it has been found that although in many cases the serum was able to counteract the blood infection, it was not possible for it to affect the source from which the infection originated, viz. :—the buboes. On account of the inflammatory and necrotic

* On the Relation of Blood to Lymphatic Vessels. By C. H. Leaf, M.B.—*The Lancet*, 3rd March 1900.

processes that generally co-exist and also the state of partial or complete encapsulation in which they have been found on *post mortem* examination, the serum does not seem to reach them and hence it is that bacilli have been found to be active in the buboes, whilst none are to be found in the blood. And therefore so long as they remain active in the buboes, they are capable of setting up fresh mischief, even though the outward manifestations of the infection may have been temporarily neutralised by the serum. The local action of the serum on the centres of infection is not much under the above circumstances and therefore it has been suggested by some, that subcutaneous injection of serum should be made as near the bubo as possible, so as to envelope it in the injected serum. This has been done in some cases, but without marked effect. There is no doubt that certain conditions exist locally in the buboes, which whilst not interfering with the multiplication of the plague bacilli, are able to retard the action of the serum, or render it ineffectual in its topical action. And so long as this condition may exist, so long the patient remains in danger of auto-infection or extension of mischief.

53. The above facts fully explain why sero-therapy did not give such good results as during the previous year. Had the conditions been the same, as in the previous epidemics, the results would have been still more encouraging, inasmuch as the serum that was used was stronger than that of last year. But under the altered circumstances of the last epidemic, we had to contend against factors which were practically not existent previously and hence our difficulties were greatly enhanced, and in the light of our present knowledge it appears, that if we had had to deal with another epidemic of the same nature, the results would be the same, unless, indeed, it were possible to so perfect the serum on the lines indicated in a former section, as to make it effective against general blood infection.

III.—THE RESULTS IN 1900-01.

54. From August 1900 to February 1901, the serum treatment was again conducted on the selection method. As no serum was available in February, only five patients were treated with it and the rest 127 as detailed further.

During the seven months comprised in the above period, 52 patients were treated with the serum, of whom 35 died and 17 recovered. The non-serum cases numbered 162, and 125 of them died and 37 recovered. The mortality rate in the former was therefore 67·30 per cent. as against 77·16 per cent. in the latter. The difference in the mortality rate between these two sets of cases would have been greater, had there been sufficient serum in February to treat all the cases that were fit for serum treatment.

The following table shows the details of the cases treated month by month :—

MONTHS.	SERUM CASES.			NON-SERUM CASES.		
	No.	Died.	Recovered.	No.	Died.	Recovered.
August 1900	4	3	1	...	..	...
September „	9	6	3	2	2	...
October „	5	4	1	...	...	...
November „ ... ..	...	...	...	4	4	...
December „	8	6	2	5	5	...
January 1901	21	12	9	24	19	5
February „	5	4	1	127	95	32
Total ...	52	35	17	162	125	37

55. Under instruction from the Special Medical Officer the alternate system of treatment was resumed from March, and the following table summarises the results for March, April and May. In order to save the serum as much as possible, it was arranged that all moribund patients falling in the serum group, as well as any convalescents, should not receive the serum, and deaths or recoveries among them should count as if they were so treated. And hence out of the 104 cases that came under this group, 32 did not receive any injections—24 because they were moribund or very late and all of whom died, and 8 because they were convalescent or semi-convalescent and all of whom recovered :—

MONTHS.	SERUM CASES.			NON-SERUM CASES.		
	No.	Died.	Recovered.	No.	Died.	Recovered.
March 1901	62	49	13	60	52	8
April „	34	26	8	35	22	13
May „	8	6	2	7	7	.....
Total ...	104	81	23	102	81	21

From the foregoing table it will be noticed that out of 104 cases treated with the serum, 81 died and 23 recovered, whereas out of 102 non-serum cases, 81 died and 21 recovered. The mortality rate, therefore, works out at 77·82 per cent. in the former, and 79·42 in the latter, a difference of 1·53 per cent. in favour of the serum, which may be ignored for all practical purposes. The combined mortality of the serum and non-serum cases works out at 78·64 per cent. which, though high as it is, would have been higher still, but for 16 convalescent cases that were included in them. If they were eliminated, there would remain 190 cases, with 162 deaths and 28 recoveries, equivalent to a mortality rate of 85·93 per cent.

56. If the above results are analysed with reference to the presence or absence of septicæmia in the patients, on admission, the results become sufficiently striking and again point to the fact, that when a patient comes to the hospital in the septicæmic condition, he has practically no chances of recovery, however he may be treated. As no systematic examination of the blood was conducted during January, 27 cases not treated with the serum have been excluded from that month, and the following analysis includes 384 cases only out of 411 total admissions:—

Serum Cases.

MONTHS.				SEPTICÆMIC CASES.			NON-SEPTICÆMIC CASES.		
				No.	Died.	Recovered.	No.	Died.	Recovered.
January	...	...	...	9	9	.....	12	3	9
February	...	...	...	3	3	.....	2	1	1
March	...	...	...	28	26	2	36	24	12
April	...	...	...	15	15	.....	19	11	8
May	...	...	...	2	2	.....	7	4	3
Total				57	55	2	76	43	33

The above table shows that out of 57 cases that were treated with the serum, in the septicæmic state, 55 died and only 2 recovered, the latter being comparatively mild cases as they showed scarcely a colony or two in the cultures. The mortality rate in them was therefore 96·66 per cent. There were 76 cases, however, on the other hand who were not septicæmic on admission and they lost only 43, and had 33 recoveries, which was equivalent to a mortality rate of 56·59 per cent. It thus appears that whereas only 3·33 per cent. of septicæmic cases recovered under the serum treatment, the percentage of recoveries in those not septicæmic was 43·41 per cent. under the same treatment, that is there was a difference of 40 per cent. in favour of the latter.

57. Turning now to the cases not treated with the serum and analysing them according as they were or were not septicæmic on admission, the results may be stated as follows:—

Non-Serum Cases.

MONTHS.	SEPTICÆMIC CASES.			NON-SEPTICÆMIC CASES.		
	No.	Died.	Recovered.	No.	Died.	Recovered.
February	48	46	2	79	49	30
March	38	38	.....	39	27	12
April	16	16	.....	23	10	13
May	6	6	.....	2	2	.....
Total ...	108	106	2	143	88	55

The non-serum septicæmic cases numbered 108, of whom 106 died and 2 recovered : the mortality rate being 98·14 per cent. There were 143 non-septicæmic cases, of whom 88 died, and 55 recovered, the mortality rate being 61·53 per cent., that is a difference of 36·66 per cent. in favour of the latter. On comparing the mortality rate in these two sets of cases they stand thus:—

	<i>Septicæmic Cases.</i>	<i>Non-Septicæmic Cases.</i>
	<i>Mortality rate.</i>	<i>Mortality rate.</i>
Serum	96·66 per cent.	56·59 per cent.
Non-serum	98·14 „	61·53 „

It is unfortunate that for purposes of accurate comparison, the complete figures for January are not available on account of 27 cases having been excluded for non-examination of blood, otherwise the difference between the non-septicæmic serum and non-serum cases would have been greater than 4·94 per cent. And it has to be remembered in this connection that this difference of nearly five per cent. was obtained in an epidemic that was characterised by such virulence and multiplicity of buboes as described above.

58. If the influence of serum is compared on the multiple and single buboes, the utility of the serum becomes self evident as shown below:—

	SERUM.			NON-SERUM.			TOTAL.		
	No.	Died.	Recovered.	No.	Died.	Recovered.	No.	Died.	Recovered.
Multiple Buboes	95	71	24	164	135	29	259	206	53
Single Axillary	19	17*	2	54	39	15	73	56	17
Other Single Buboes	18	8	10	40	21	19	58	29	29
Pneumonic	3	3	...	7	7	...	10	10	...
Without Apparent Buboes ... ..	...	...	...	11	11	...	11	11	...
Total ...	135	99	36	276	213	63	411	312	99

* Almost all of these cases did not receive any serum as they were moribund, and 15 of them had secondary pneumonia as a complication.

The recovery rates may be compared thus :—

	<i>Serum.</i>	<i>Non-serum.</i>
Multiple Buboes	25·26 per cent.	15·24 per cent.
Axillary Buboes	10·53 "	27·77 "
Other Single Buboes	55·55 "	47·50 "

Except, therefore, in the case of single axillary buboes where, for the reason stated above, the recovery rate is higher than in the non-serum cases, the serum group shows better results—in multiple buboes by 10 per cent., and in single buboes by 8 per cent. And although, at first sight, the results taken as a whole did not show any difference, an analysis of the cases as above at once reveals, whether the serum has been useful or not, and to what extent.

59. The only point that now remains for consideration with reference to the last epidemic is the treatment of plague with Professor Gajjar's Liqr. Iodi Terechloridi. During January and February it was used in a few *selected* cases only and an attempt was made in March to give it in every other case alternately with the serum, but on account of the virulence of the epidemic, and the incessant vomiting that it encouraged in patients that were prone to be sick, it could not be used and hence selection had again to be resorted to. The number of *selected* cases thus treated was 62, of whom 40 died, and 22 recovered, the mortality rate being 64·51 per cent. During April and May, it was used alternately with the serum ; during the former month 35 cases were treated, of whom 22 died, and 13 recovered and in the latter 7, all of whom died. Thus out of 42 cases, 29 died and 13 recovered, the mortality rate being 69·04. There were 20 septicæmic cases among the above, all of whom died, and of the rest (22) all non-septicæmic 9 died and 13 recovered. The chances inseparably connected with the alternate method of treatment, unduly favoured the latter, inasmuch as out of the 13 recoveries, 10 were in cases with single buboes. No definite conclusion as to the efficacy of the drug could be drawn from such a small number of observations, but it has been possible to determine that it has no effect in septicæmic cases, that it is innocuous, and safe in use, and that as much as one ounce of the liquor could be given and tolerated within twenty-four hours. As to whether it possesses any specific properties, and is able to neutralise the intrapotoplasmic poison of the plague microbes, further observations and experiments on animals can alone demonstrate.

I have the honour to be,

Sir,

Your most obedient Servant,

N. H. CHOKSY, M.D.,

Special Asst. Health Officer.

TABLE showing the details of cases treated with Lustig's serum for the Month of February 1901.

Register No.	Date of Admission.	Names.	Age.	Sex.	Caste.	Duration of Disease.	Bubo.	Quantity injected, c.c.	RESULT.		REMARKS.
									Died.	Cured.	
	1901.					Days.					
206	1st Feb.	Roza Rebello	...	Female.	Christ.	5	Left Femoral & Inguinal	630 c.c.	...	Recovered.	
210	1st do.	Vishram Khemjee	...	Male ...	Mussl.	3	Right Inguinal	300 "	Died ...	.....	Death from gradual heart failure.
215	2nd do.	Baptista Lobo	...	Male ...	Christ.	2	Left Femoral, Inguinal and Iliac	200 "	" ...	.....	Death within 12 hours of admission from heart failure.
214	2nd do.	Asharabai Nana	...	Female.	Hindoo	4	Left Femoral, Inguinal and Iliac	200 "	" ...	.....	Do. do.
219	2nd do.	C. P. Cardoz	...	Male ...	Christ.	3	Left Femoral, Inguinal and Iliac	300 "	" ...	.....	Death from sudden heart failure.

TABLE showing the details of cases treated with Lustig's serum for the Month of March 1901.

No.	Register No.	Date of admission.	Names.	Age.	Sex.	Caste.	Duration of Disease.	Bubo.	Non-Septicæmic— Septicæmic:— Few colonies+ Many colonies++ Innumerable+++ + after =	Quantity injected	Result.	Remarks.
1	451	3rd Mar.	Casimir Fernandes	20	Male	Christian	3	Right femoral, inguinal and iliac.	+	400 c. c.	Died	Coffee-ground vomiting, secondary bubo, left iliac.
2	456	"	Rudka Sukhai	19	"	Hindu	3	Right femoral, inguinal and iliac.	+	200 c. c.	"	Secondary bubo, right axillary.
3	461	4th Mar.	Francis Minguel	8	"	Christian	3	Left posterior, cervical and sub-maxillary.	+	200 c. c.	"	Secondary bubo, right posterior cervical.
4	463	"	Purshotam Govind	25	"	Hindu	30	Left femoral (open)...	+	Not injected	"	Lumbar and iliac abscesses On P. M. examination; plaque pyæmia.
5	467	"	Puran Ghashoo	35	"	"	2	Left axillary	=	1145 c. c.	"	Marasmus.
6	471	5th Mar.	Mariam Mohomed	20	Female	Mussulman	2	Left inguinal	+	1070 c. c.	"	70 c. c. intravenous; had miscarriage before admission; life prolonged for 5 days.
7	474	6th Mar.	Govind Mahadoo	24	Male	Hindu	3	Left femoral, inguinal and iliac.	=	170 c. c.	Recovered.	
8	478	7th Mar.	Zingi Khandoo	20	Female	"	3 ?	Left axillary	=	1160 c. c.	Died	Life prolonged for 7 days, secondary bubo, left femoral.
9	481	8th Mar.	Mohamad Saheb	12	Male	Mussulman	10	Double sub-maxillary submental and left parotid.	+	Not injected.	Recovered.	

TABLE showing the details of cases treated with Lustig's serum for the Month of March 1901—continued.

No.	Register No.	Date of admission.	Names.	Age.	Sex.	Caste.	Duration of Disease.	Bubo.	Non-septicæmic— Septicæmic:— Few colonies+ Many colonies++ Innumerable+++ Fæter=	Quantity injected	Result.	Remarks.
10	488	1901. 9th Mar.	C. P. Pinto	45	Male	Christian	3 Days.	Right axillary infiltration.	++	420 c. c.	Died	...
11	492	10th "	J. P. Almeida	60	"	"	3	Right femoral, inguinal and iliac.	—	200 c. c.	"	... Death from œdema of lungs; subcutaneous hæmorrhage in large patches on trunk and back.
12	498	"	Pascal Rodrigues	25	"	"	2	Double femoral, inguinal and iliac	+ and also staphylococcus septicæmia.	400 c. c.	"	... Double infection; meningitis.
13	500	"	Janabai Balkrishna	30	Female	Hindu	1	Left axillary () very small.	+	850 c. c.	"	... Secondary bubo, double posterior cervical.
14	501	11th Mar.	Chandri Babia	22	"	"	8?	Left femoral, inguinal and iliac.	+	Not injected.	"	... Moribund on admission not injected.
15	506	"	St. Anne J. De Costa	30	"	Christian	4	Right posterior, cervical and necrosis on cheek.	—	550 c. c.	Recovered.	Plague and small-pox.
16	510	"	Shantaram Annunt	12	Male	Hindu	3	Left axillary with infiltration.	—	470 c. c.	Died	Meningitis.
17	516	12th Mar.	Soma Poonjia	30	"	"	2	Left femoral, inguinal and iliac.	—	2405 c. c.	Recovered.	Injections continued for 2 days on account of secondary pneumonia and secondary buboes, right femoral, inguinal and iliac.
18	504	11th Mar.	Sonoo Luxman	16	"	"	3	Left supratrochlear and necrosis on elbow.	+++ and also staphylococcus septicæmia.	500 c. c.	Died	... Secondary pneumonia and double axillary.

19	525	13th	Mar.	Balla Naroba	...	35	...	...	...	7	Left femoral, inguinal and iliac, necrosis on hep joint.	+	+	+	Not injected.	"	... Moribund on admission; not injected.
20	527	"	"	Nabai Ragho	...	35	Female.	"	...	?	Right femoral, inguinal and iliac.	+	+	+	"	"	... Moribund on admission; not injected.
21	503	14th	Mar.	Shiveram Deoji	...	15	Male	...	...	5	Right axillary infiltration.	=			1580 c. c.	...	Recovered. Secondary buboes and pneumonia, marasmus and secondary infection.
22	530	"	"	Eneas St. Anne Cardoz	...	25	"	...	Christian	3	Right axillary infiltration.	-			Not injected.	1.	Died. Moribund on admission; not injected.
23	534	"	"	Domingo Borges	...	50	"	...	"	4	Left axillary and brachial.	=			600 c. c.	...	Secondary pneumonia.
24	538	15th	Mar.	Tatia Narayen	...	20	Male	...	Hindu	5	Left femoral, inguinal and iliac.	-			950 c. c.	...	Life prolonged for 7 days.
25	543	"	"	Jani, wife of Harji	...	30	Female.	"	"	2	Right axillary.	+			500 c. c.	...	Secondary buboes, left femoral, inguinal and iliac.
26	545	"	"	Rowji Krishna	...	25	Male	...	"	2	Right axillary with infiltration.	=			500 c. c.	...	Coffee-ground vomiting, left femoral, inguinal and iliac.
27	547	"	"	Hari Bhayaji	...	22	"	...	"	2	Left femoral, inguinal and iliac.	+	+		Not injected	"	Moribund; not injected.
28	553	"	"	Tookaram Nathiaram	...	30	"	...	"	3	Right femoral, inguinal and iliac.	-			"	...	do.
29	556	16th	Mar.	Lawrence Fernandez	...	50	"	...	Christian	2	Left femoral, inguinal and iliac.	-			550 c. c.	...	do.
30	559	"	"	Narayen Dowlatia	...	30	"	...	Hindu	4	Pneumonic plague.	+			Not injected	"	do.
31	560	"	"	Bhikoo Baloo	...	25	"	...	"	6	Right femoral, inguinal and iliac.	-			"	...	Moribund; not injected; subconjunctival hæmorrhage.
32	562	"	"	Kaloo Behari	...	20	"	...	"	8	Right femoral, inguinal and iliac.	+	?		"	...	Recovered. Convalescent, not injected.
33	568	"	"	Sayamma Pochaya	...	7	Female.	"	"	2	Right femoral, inguinal and iliac.	=			630 c. c.	...	"
34	572	18th	Mar.	Esther Nathaniel	...	11	"	...	Christian	2	Left femoral, inguinal and iliac.	=			1090 c. c.	...	Died. Coffee-ground vomiting; general convulsions, secondary bubo, right femoral, inguinal and iliac. Death from exhaustion and marasmus.

TABLE showing the details of cases treated with Lustig's serum for the Month of March 1901—concluded.

No.	Register No.	Date of Admission.	Names.	Age.	Sex.	Caste.	Duration of Disease.	Bubo.	Non-Septicæmic— Septicæmic:— New colonies + Many colonies + Innumerable + + + + after =	Quantity Injected c. c.	Result.	Remarks.
1901.												
35	574	18th Mar.	Hanook Harjee	12	Male	Hindu	3	Left femoral, inguinal and iliac.	—	480 c. c. ...	Died	Coffee-ground vomiting.
36	557	"	Divali Hanook	7	Female	"	3	Left posterior cervical	=	650 c. c. ...	Recovered	Secondary bubo, double femoral, inguinal and iliac.
37	578	"	Suleman Ismail	50	Male	Musalman	2	Left axillary with infiltration.	+	400 c. c. ...	Died	Secondary pneumonia, coffee-ground vomiting.
38	570	"	Rama Mahadoo	30	"	Hindu	2	Left posterior cervical	—	610 c. c. ...	Recovered	Thympanites; very violent delirium.
39	576	"	Balla Sakharan	25	"	"	4	Right posterior cervical & left femoral, inguinal and iliac.	+	620 c. c. ...	"	Old case of relapsing fever with plague infection.
40	581	"	Govind Mahadoo	33	"	"	2	Right femoral, inguinal and iliac.	=	680 c. c. ...	Died	Secondary bubo, left femoral, inguinal and iliac.
41	586	"	David Isaac	25	"	Jew	3	Left femoral, inguinal and iliac.	—	200 c. c. ...	"	Coffee-ground vomiting.
42	588	"	Matilda Almeida	15	Female	Christian	2	Right axillary.	+	2250 c. c. ...	"	Secondary buboes; marasmus.
43	592	"	Ramchandra Narayan	35	Male	Hindu	4	Left femoral, inguinal and iliac.	+	Not injected	"	Moribund; not injected.
44	594	19th Mar.	Sonabai Soma	25	Female	"	3	Right femoral, inguinal and iliac.	—	300 c. c. ...	"	"
45	599	20th Mar.	Mahipaty Canoo	20	Male	"	4	Left axillary with infiltration	—	400 c. c. ...	"	"
46	603	"	Mahadoo Dhondoo	10	"	"	2	Right femoral, inguinal and iliac.	—	Not injected	"	Moribund and not injected.

47	608	21st Mar...	Krishna Saktharam	...	30	Female	"	...	3	Double femoral, ingui- nal and iliac.	+	500 c.c. ...	"	...	Coffee-ground vomiting; typanites.
48	613	22nd Mar...	Gangabai Badal	...	30	"	"	...	2	Right femoral, ingui- nal and iliac.	×	2150 c.c. ...	"	...	Coffee-ground vomiting; typanites.
49	618	"	Dattaram Bapoo	...	23	Male	"	...	8	Left posterior cervical and subaxillary...	=	200 c.c. ...	"	...	Late case; secondary buboes, right femoral, inguinal and iliac.
50	624	23rd Mar...	Ratna Dondoo	...	8	"	"	...	2	Right posterior cervi- cal ...	-	160 c.c. ...	"	...	Hypersyrexia before death, Temp, 107.4
51	631	24th Mar...	Govind Cannoba	...	28	"	"	...	1	Right inguinal and iliac...	-	690 c.c. ...	"	...	
52	634	"	Manuel Correa	...	58	"	Christian	...	4	Right axillary with in- filtration. ...	+	330 c.c. ...	"	...	80 c.c. intravenous.
53	637	"	Krishni Mahadoo	...	30	Female	Hindu	...	...	Left axillary ...	+	Not injected	"	...	Moribund; not injected.
54	644	25th Mar...	Hussin Heerawan	...	23	Male	Musalman	...	5	Left femoral, ingui- nal and iliac.	=	1150 c.c. ...	"	...	Secondary pneumonia; 160 c.c. intravenous.
55	649	26th Mar...	Chimaji Bhawoo	...	40	"	Hindu	...	5	Right femoral, ingui- nal and iliac.	-	850 c.c. ...	"	...	Typanites.
56	651	27th Mar...	Conceicao L. Dias	...	12	Female	Christian	...	2	Right axillary with in- filtration.	+	400 c.c. ...	"	...	80 c.c. intravenous.
57	654	"	Ponam Kanji..	...	25	"	Hindu	...	2	Left femoral, ingui- nal and iliac.	-	1150 c.c. ...	Recovered.		
58	663	28th Mar...	Bhoota Padma	...	30	Male	"	...	2	Double femoral, in- guinal and iliac.	+	Not injected	Died	...	Moribund; not injected.
59	665	29th Mar...	Kandahising Pratipal- siugh	...	45	"	"	...	5	Left femoral, ingui- nal and iliac.	+	650 c.c. ...	"	...	Typanites.
60	675	31st Mar	Savatribai Sadhoo	...	50	Female..	"	...	10	Right femoral, ingui- nal, iliac and left fe- moral.	+	Not injected.	"	...	Moribund; not injected.
61	677	"	Dondoo Rajoo	...	25	Male	"	...	5	Right iliac ...	-	1880 c.c. ...	Recovered.		Secondary; pneumonia, peri- tonitis.
62	671	"	Budhoo Sakali	...	35	"	"	...	2	Left femoral, inguinal and iliac.	-	900 c.c. ...	"	...	Secondary staphylococcus, in- fection in blood; men- ingitis.

N.B.—Where Septicæmia was confirmed sometime after admission, the cases are marked—in the column for Septicæmia.

TABLE showing the details of cases treated with Lustig's serum for the month of April 1901.

No.	Regd. No.	Date of admission.	Names.	Age.	Sex.	Caste.	Duration of disease.	Bubo.	Non-Septicæmic— Septicæmic: — Few Colonies+ Many Colonies++ Innumerable+++	Quantity injected &c.	Result.	Remarks.
63	681	1st April.	Mahadoo Babaji.	36	Male	Hindu	...	5 Right axillary with infiltration.	+++	Not injected	Died	... Moribund; not injected.
64	685	2nd April.	Naba Chokoo	25	Female	"	...	2 Left axillary	=	270 c. c.	"	... Secondary pneumonia.
65	692	3rd April.	Yesoo Krishna	20	Male	"	...	2 Left femoral, inguinal and iliac.	+++	Not injected	"	... Moribund; not injected.
66	696	"	Battosi Gokhran.	40	Female	"	...	3 Left axillary with infiltration.	=	200 c. c.	"	... Secondary pneumonia.
67	700	"	R a h i m b u x 40 Mahomdi.	40	Male	Mussalman	...	25 Right iliac	—	Not injected	Recovered	Convalescent; bubo very large, soft and fluctuating.
68	689	"	Shekh Ali Abdul 50 Kadir.	50	"	"	...	3 Left inguinal and iliac.	—	400 c. c.	Died	...
69	705	4th April.	Durga Homaji	5	Female	Hindu	...	8 Right inguinal	—	Not injected	Recovered	Convalescent.
70	710	"	Ibrahim Haji	24	Male	Mussalman	...	3 Right axillary with infiltration.	+++	"	Died	... Moribund; not injected.
71	721	6th April.	Ratno Vithoo	33	"	Hindu	...	4 Right axillary with infiltration.	+++	400 c. c.	"	...
72	717	"	Krishna Luxman	14	"	"	...	6 Left axillary with infiltration.	=	Not injected	"	... Moribund; secondary pneumonia; not injected.
73	725	7th April.	Bhanoo Ramji	30	"	"	...	4 Right femoral, inguinal and iliac.	—	500 c. c.	"	... Tympanites.
74	742	8th April.	Datto Yeshvant.	30	"	"	...	5 Right femoral, inguinal iliac and necrosis on calf.	+++	100 c. c.	"	... Secondary pneumonia.
75	745	9th April.	Dugroo Krishna.	8	"	"	...	10 Left posterior cervical.	—	Not injected	Recovered	Convalescent; bubo open.

76	752	11th April.	Magdalena gamo.	Kil-45	Female	Christian	...	3	Left femoral, inguinal and iliac.	...	700 c. c.	...	Died	...
77	764	12th April.	Anna Mary Fernandes.	40	"	"	...	3	Left femoral, inguinal and iliac.	...	840 c. c.	...	Recovered.	...
78	759	"	Dhakoo Govind.	20	Male	Hindu	...	3	Right axillary with infiltration.	...	2000 c. c.	...	Died	... Secondary buboes, double femoral, inguinal and iliac. Death from Staphylococcus septicaemia.
79	756	"	Augustine Dias.	13	"	Christian	...	3	Double iliac and right axillary.	...	100 c. c.	...	"	... Secondary, right posterior cervical.
80	768	13th April.	Dhondoo Ganoo.	30	"	Hindu	...	5	Right femoral inguinal and iliac.	Cocci.	180 c. c.	...	"	... Semi-moribund on admission.
81	771	15th April.	Kanee Kalia	30	Female.	"	...	?	Left femoral, inguinal, and iliac.	+++	Not injected.	...	"	... Moribund, not injected.
82	797	18th April.	Bholaram Shan-ker.	30	Male	"	...	4	Left femoral, inguinal and iliac.	+++	"	...	"	...
83	801	"	Sadoo Luxman.	30	"	"	...	5	Left axillary and left posterior cervical.	+++	"	...	"	... Not injected because almost pulseless on admission. Secondary buboes double femoral; Right sub-maxillary.
84	803	"	Savi Bhavoo	9	Female.	"	...	2	Left posterior cervical.	+++	220 c. c.	...	"	...
85	805	"	Bachoo Chiloo	22	Male	"	...	3	Right femoral, inguinal and iliac.	=	1020 "	...	Recovered	... Secondary pneumonia.
86	808	"	Harnee Bheema.	30	Female.	"	...	4	Right Supra-trochlear.	+	260 "	...	Died	... Do. do.
87	810	"	Gunee Govind	30	"	"	...	5	Pneumonic	+++	Not injected	...	"	...
88	806	"	Shitee Krishna	20	"	"	...	5	Left axillary and right pectoral.	=	1420 c. c.	...	"	... Secondary pneumonia.
89	799	"	Luxman Krishna	20	Male	"	...	4	Double axillary	+++ and cocci	1260 "	...	"	... Plague and staphylococcus septicaemia Secondary pneumonia; left femoral and iliac buboes secondary.

TABLE showing the details of cases treated with Lustig's serum for the Month of April 1901—concluded.

No.	Regt. No.	Date of admission.	Names.	Age.	Sex.	Caste.	Duration of Disease.	Bubo.	Non-Septicæmic— Septicæmic— Few Colonies + Many Colonies ++ Innumerable. +++	Quantity injected, c. c.	Result.	Remarks.
90	822	19th April	Abdool Khan	50	Male	...	49	Left inguinal and iliac.	—	Not injected.	Recovered.	Convalescent.
91	829	20th April	Nur Khan. Govind Bhagia	20	"	... Hindu	3	Double axillary	=	2230 c. c.	Died	Double femoral and inguinal; secondary pneumonia.
92	845	23rd April	Sakoo Gopal	12	Female	"	15	Left axillary	—	Not injected.	Recovered.	Semi-convalescent.
93	853	25th April	Kashi Baloo	6	"	"	4?	Left axillary and right femoral, inguinal and iliac.	Cocci	1300 c. c.	Died	Plague and staphylococcus septicæmia on admission.
94	859	"	Bhairoo Nowjee	28	Male	"	3	Left femoral, inguinal and iliac.	—	620 "	Recovered.	Plague and small pox.
95	862	26th April	Keroo Ooma	11	"	"	1	Right femoral, inguinal and iliac.	++	220 "	Died	Sudden heart failure.
96	872	29th April	Jance Yella	6	Female	"	2	Left femoral, inguinal and iliac.	in-?	200 "	"	Pulse almost imperceptible on admission.

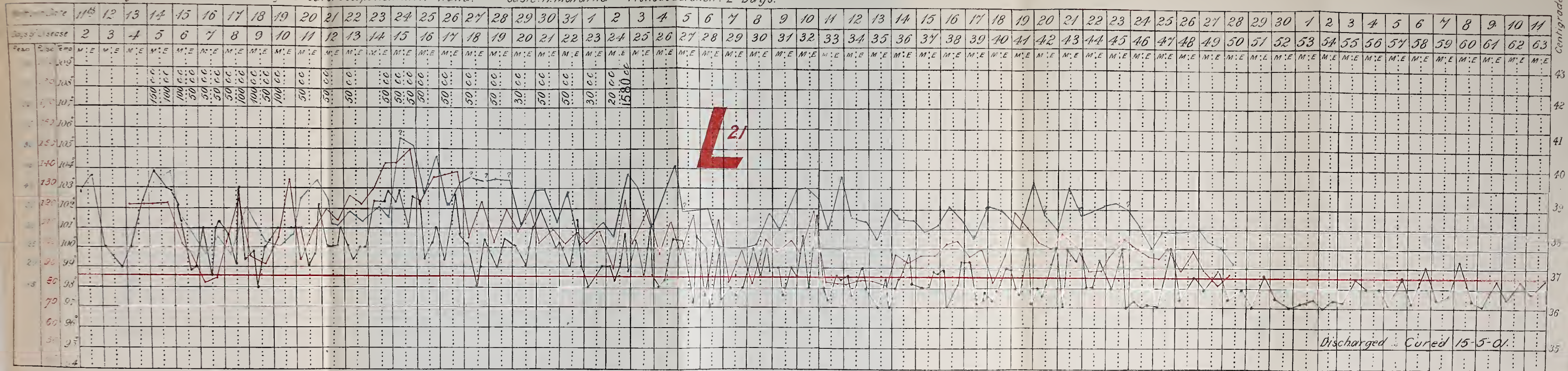
TABLE showing the details of cases treated with Lustig's serum for the Month of May 1901.

No.	Register No.	Date of admission.	Names.	Age.	Sex.	Caste.	Duration of disease.	Bubo.	Non-septicæmic— Septicæmic: — Few colonies + + + Many colonies + + + + Innumerable + + + +	Quantity injected.	Result.	Remarks.
		1901.					Days.					
97	875	1st May	Kondibai Bandoo	25	Female	Hindu	...	4	Left femoral, inguinal and iliac.	Not injected.	Died	Secondary pneumonia.
98	831	"	Bhagoobai Rama	30	"	"	...	6 ?	Right axillary with + + + and cocci...	"	"	"
99	838	2nd "	Salvador Louis	25	Male	Christian.	...	12	Right femoral ... Cocci ...	"	Recovered.	Semi-convalescent.
100	899	5th "	Mahadoo Ittoo	19	"	Hindu	...	6	Left axillary double-femoral + + +	"	Died	"
101	302	6th "	Dowlatis Pandoo	36	"	"	...	7 ?	Right femoral, inguinal and iliac.	440 c.c.	Recovered.	"
102	916	8th "	Raghoo Ramjee	32	"	"	...	8 ?	Left inguinal and iliac	720 c.c.	Died	Meningitis.
103	925	13th "	Govind Namia	18	"	"	...	4	Pneumonic plague ... =	650 c.c.	"	Plague and diplococcus Pneumonia.
104	946	16th "	Husain Mobidin	13	"	Mussalman	...	7 ?	Right femoral, inguinal and iliac.	240 c.c.	"	Commencing heart failure on admission.



PLAGUE

Name: Shivram Dejee Sex: Male. Age: 15 Years. Occupation: Mill-hand. Caste: H. Maratha Previous Duration: 2 Days.





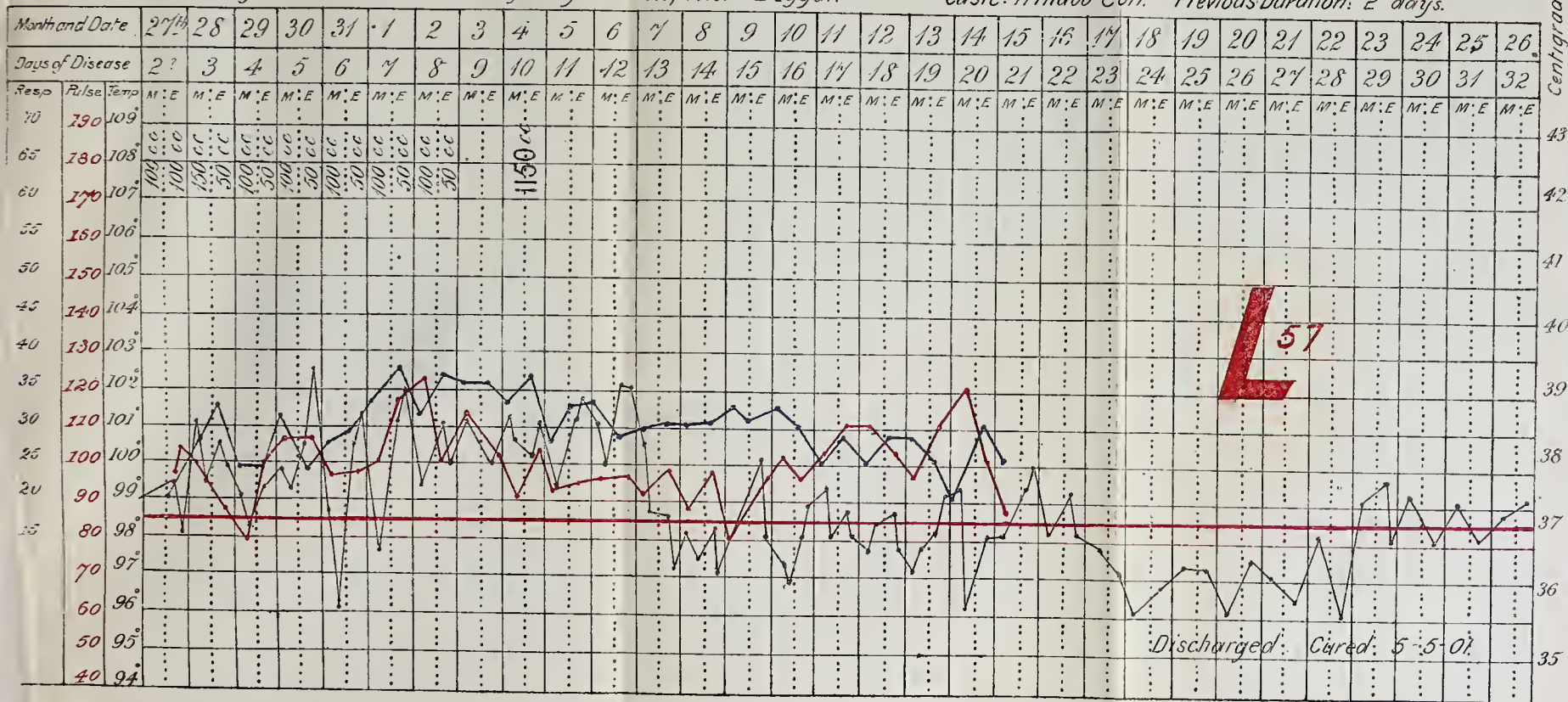
Date of Admission: 27th March 1901 at 3:50 p.m. MUNICIPAL HOSPITAL FOR INFECTIOUS DISEASES, Arthur Road.

General Number: 654

Diagnosis **PLAGUE**

Name: Pram w. of Canjée Sex: Female Age: 25 years Occupation: Beggar.

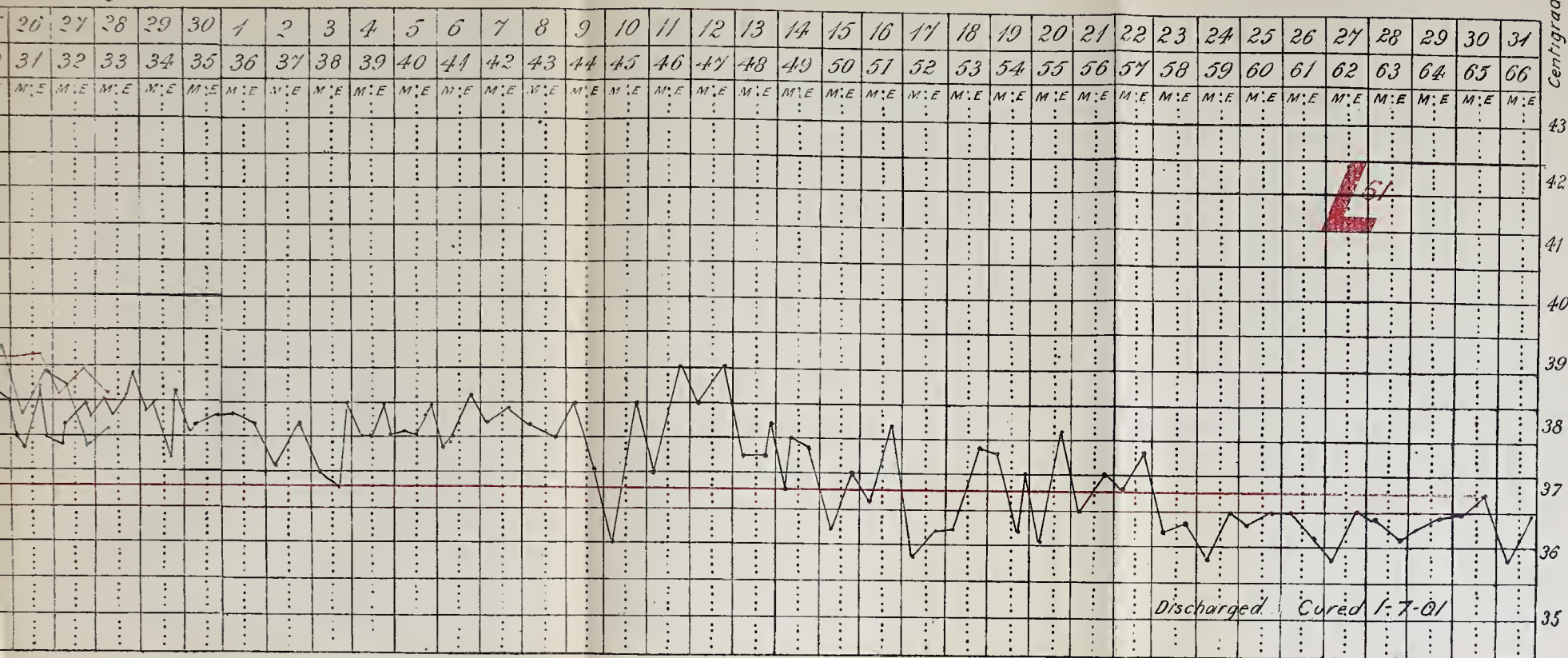
Caste: Hindoo Coli. Previous Duration: 2 days.





PLAGUE

from 5 days.







Date of Admission 12th March 1901 at 10 a.m.

MUNICIPAL HOSPITAL FOR INFECTIOUS DISEASES Arthur Road

Diagnosis **PLAGUE**

General Number 516

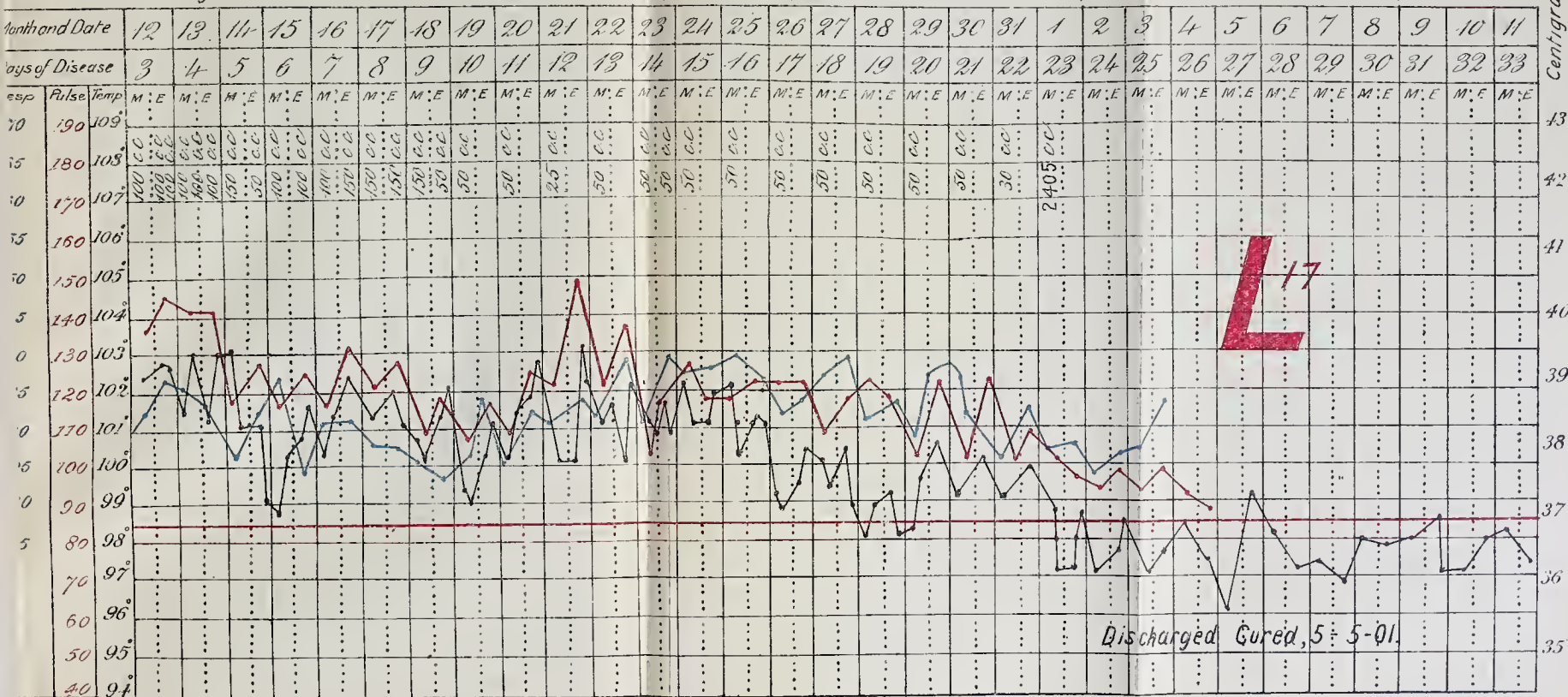
Name: Soma Poonjia

Sex: Male

Age 30 years Occupation: Sweeper

Caste: H. Sweeper

Previous Duration: 3 days





Date of Admission: 18th April at 4-30 p.m.

MUNICIPAL HOSPITAL FOR INFECTIOUS DISEASES

Diagnosis **PLAGUE**

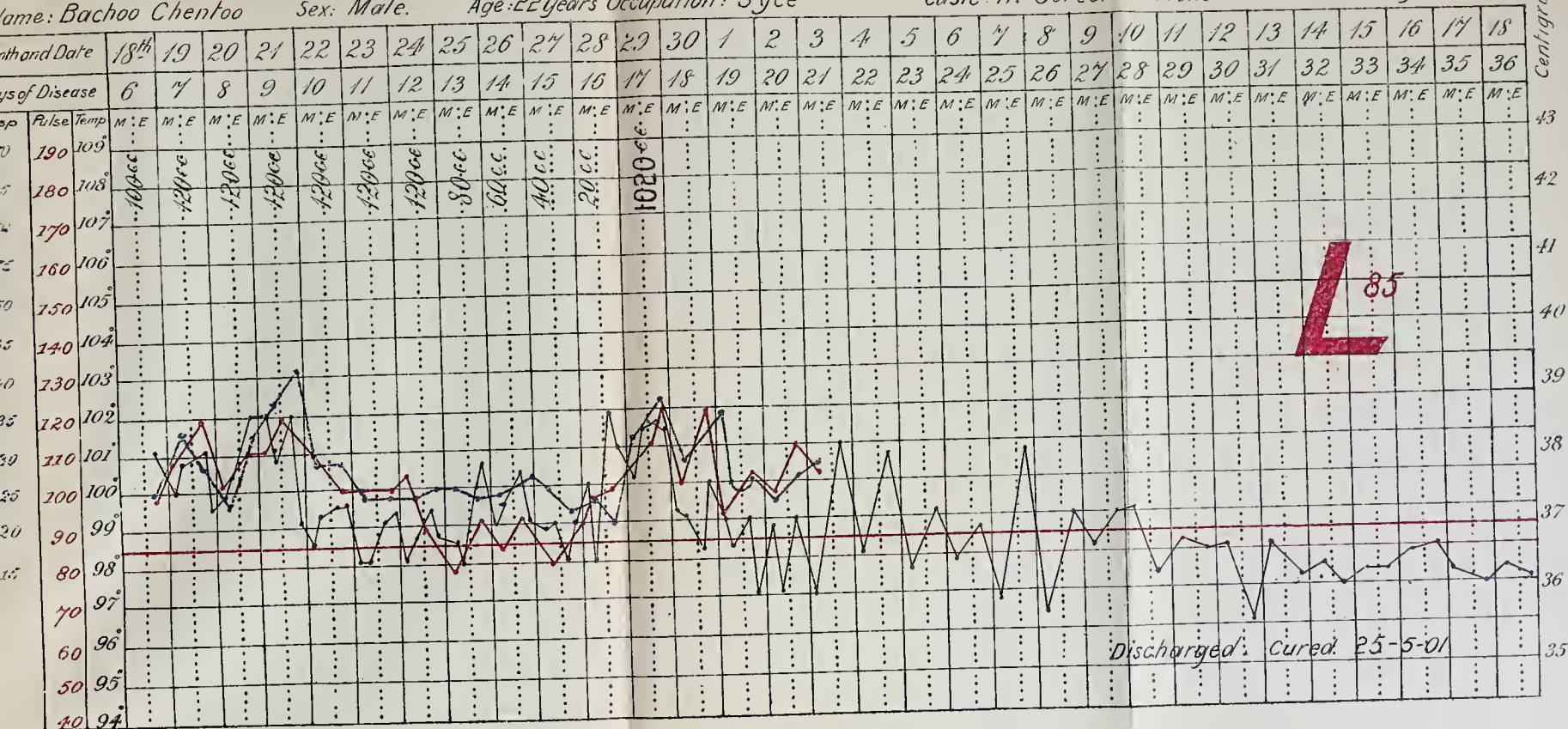
General Number: **805**
Name: Bachoo Chentoo

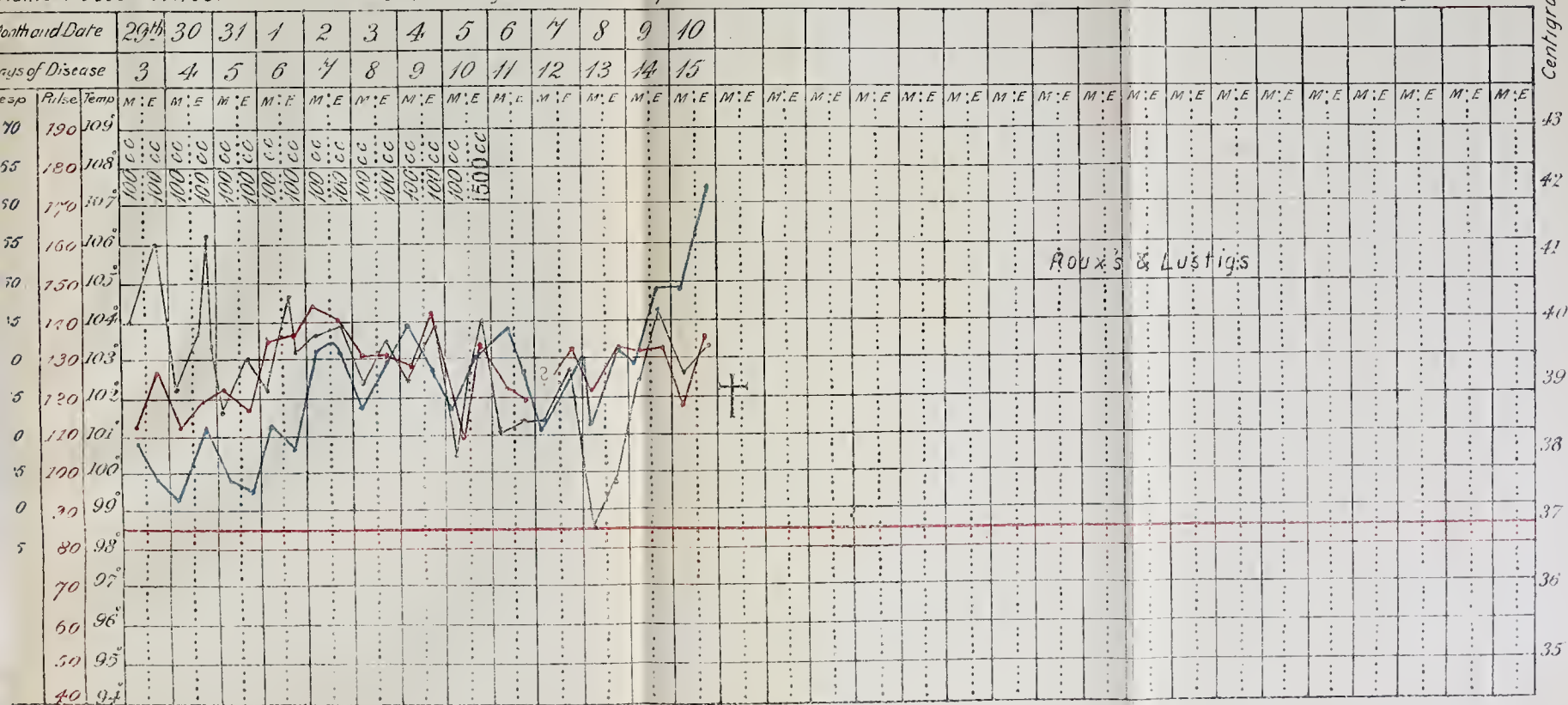
Sex: Male.

Age: 22 years Occupation: Syce

Caste: H. Coree.

Previous Duration: 6 days.







Date of Admission: 4th March 1901. at 4.30 p.m

MUNICIPAL HOSPITAL FOR INFECTIOUS DISEASES, Arthur Road

Diagnosis **PLAGUE**

General Number **467**

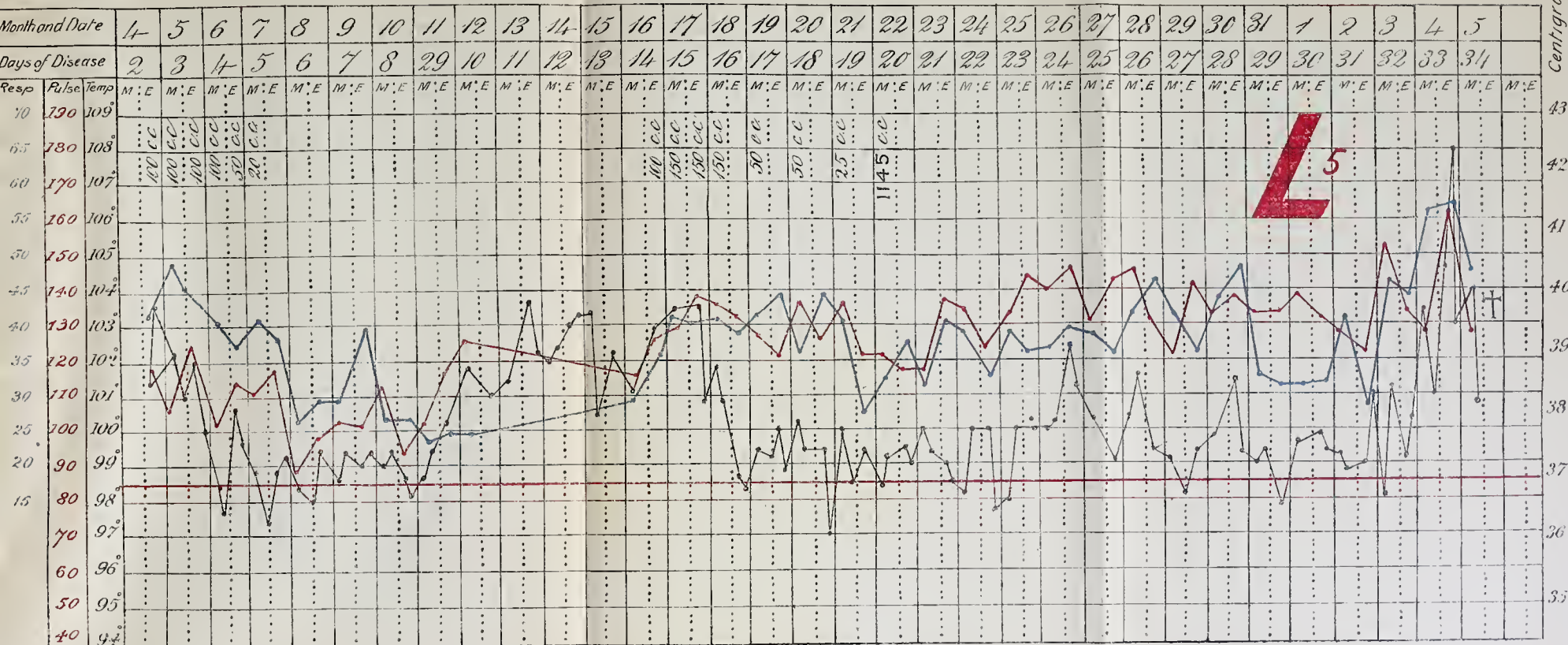
Name: Pooran Ghassoo

Sex: Male

Age: 25 years Occupation: Shoe-maker

Caste: H. Mochi

Previous Duration: 2 days



Centigrade

43

42

41

40

39

38

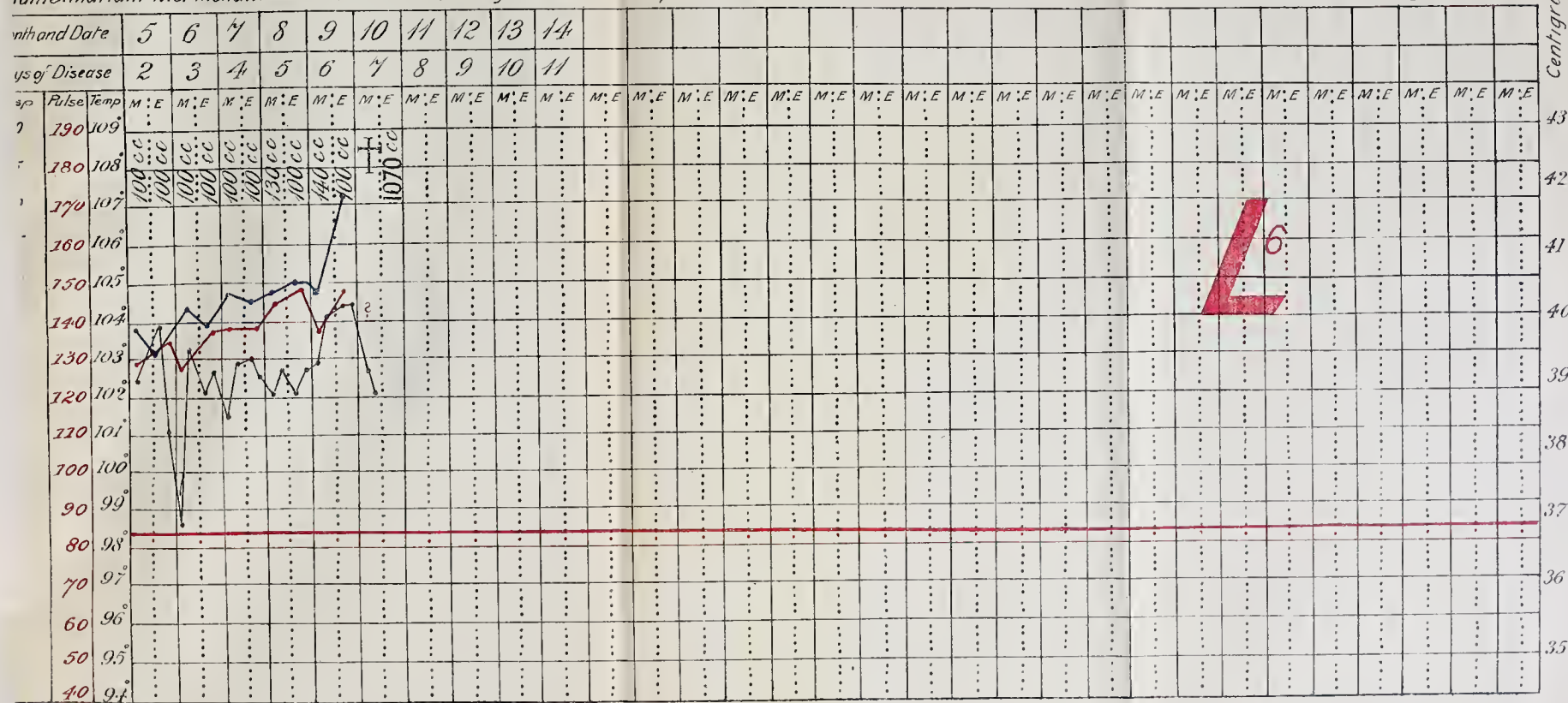
37

36

35



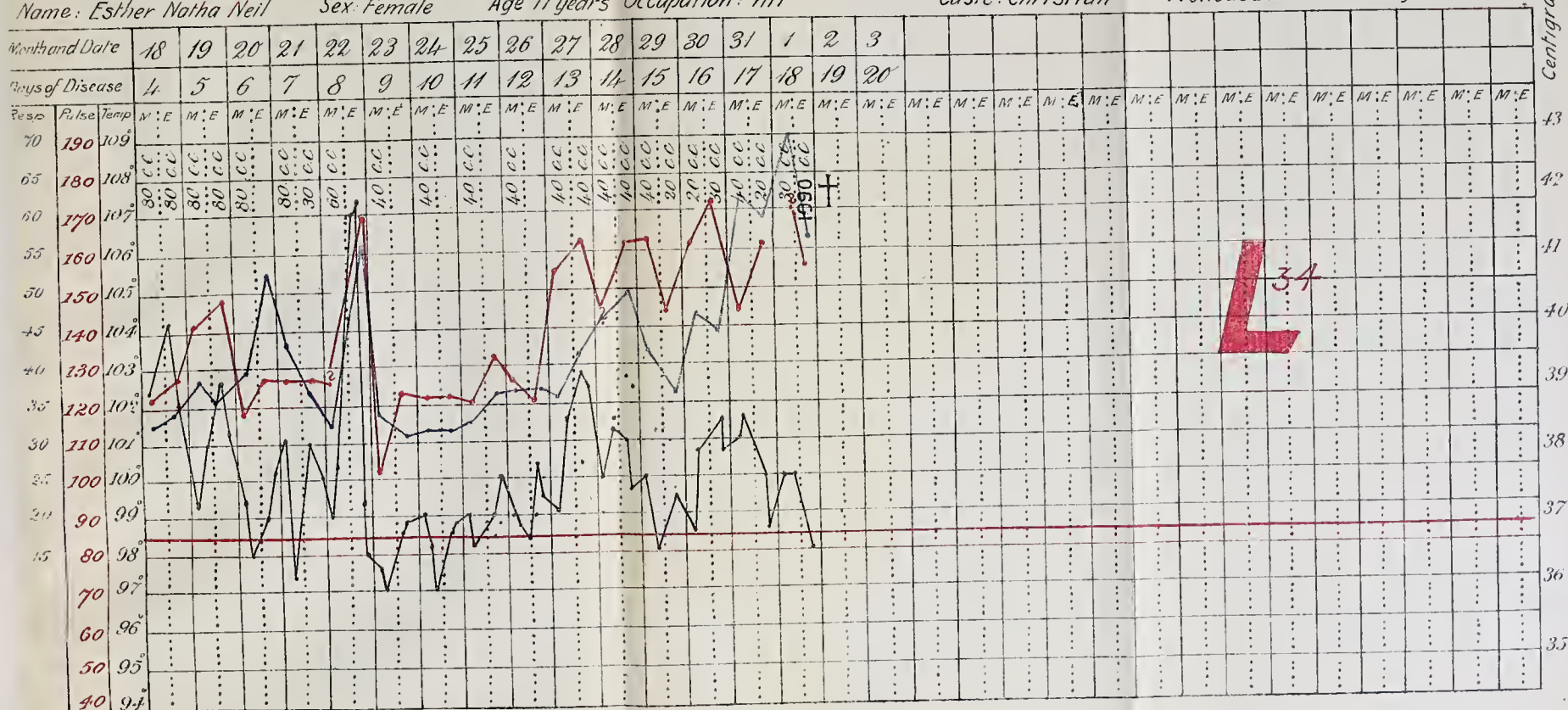
Previous Duration: 2 days.





Diagnosis **PLAGUE**

Previous Duration: 4 days



Previous Duration: 2 days.

Month and Date	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Days of Disease	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Pulse	190	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	0	10	20	30	40	50	60	70	80	90	100	110
Temp	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79
M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.	M.E.

Previous duration: 2 days.

L 42

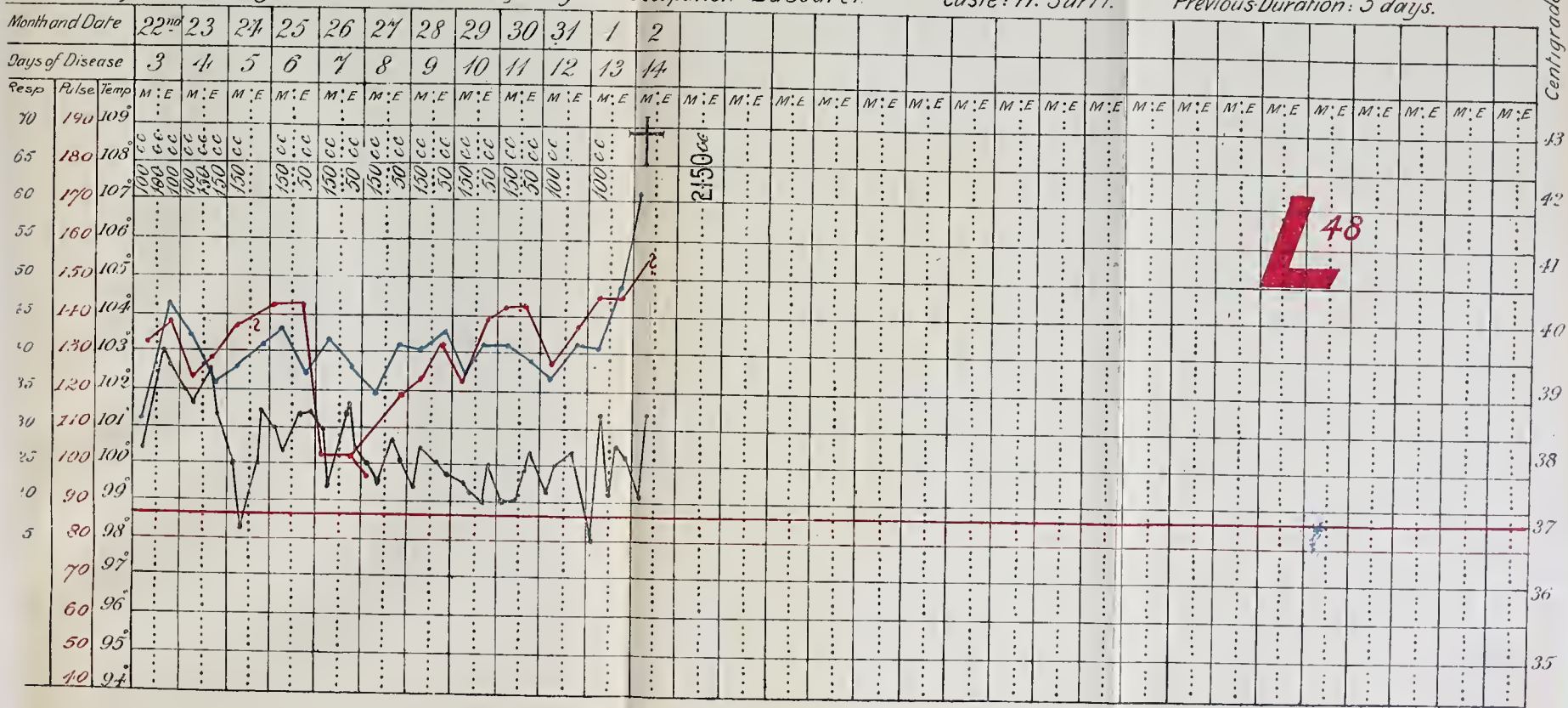
Date of Admission: 22nd March 1901 at 10-15 a.m. MUNICIPAL HOSPITAL FOR INFECTIOUS DISEASES

General Number: 613

Name: Gungabai Vaothalga. Sex: Female. Age: 30 years. Occupation: Labourer.

Caste: H. Surti.

Diagnosis **PLAGUE**
Previous Duration: 3 days.





Date of Admission: 25th March 1901 at 6-30 p.m. MUNICIPAL HOSPITAL FOR INFECTIOUS DISEASES. Arthur Road.

Diagnosis **PLAGUE**

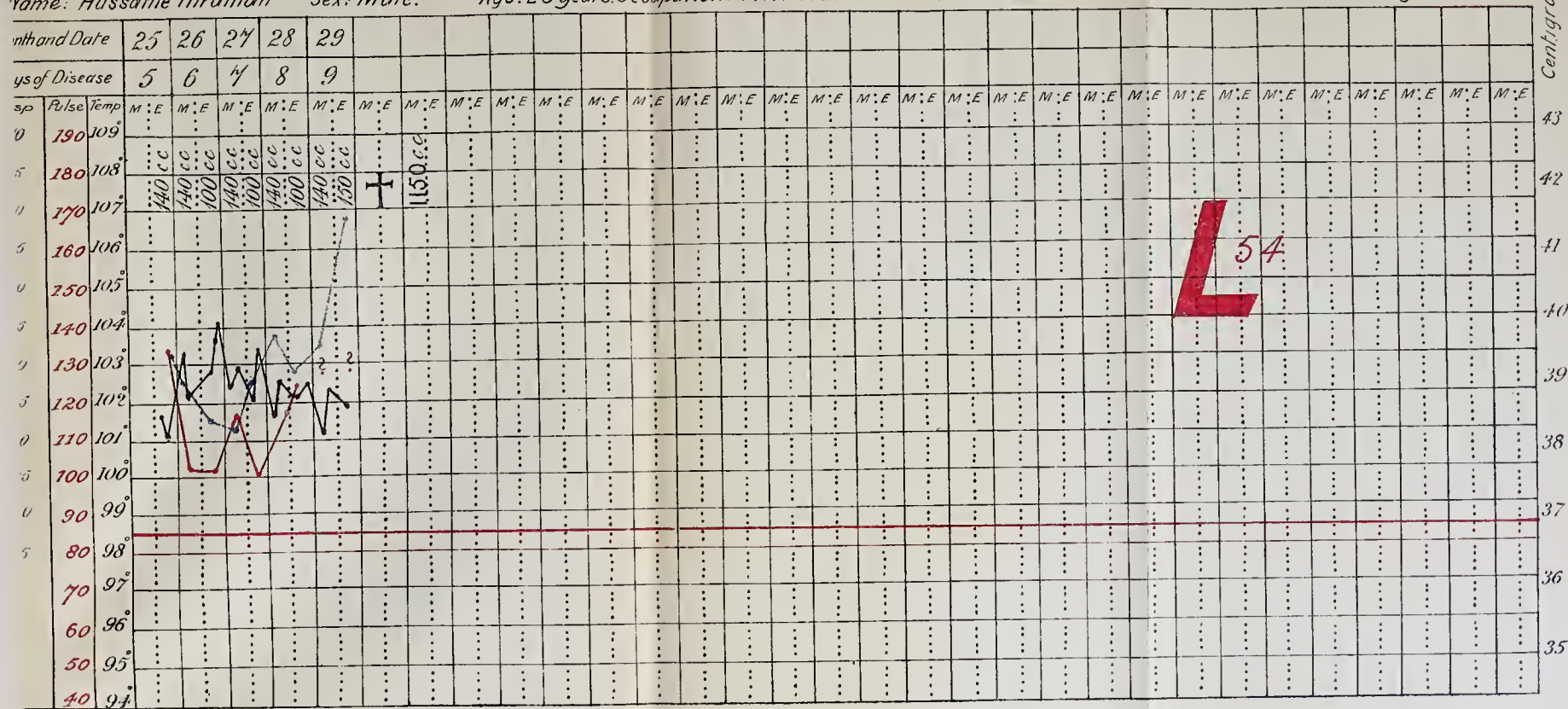
General Number: 644

Name: Hussame Hiramman Sex: Male.

Age: 23 Years. Occupation: Mill Hand.

Caste: Mussulman.

Previous Duration: 5 days.







Date of Admission: 11th April 1901 7-40 p.m. MUNICIPAL HOSPITAL FOR INFECTIOUS DISEASES Arthur Road

General Number: 759

Diagnosis **PLAGUE**

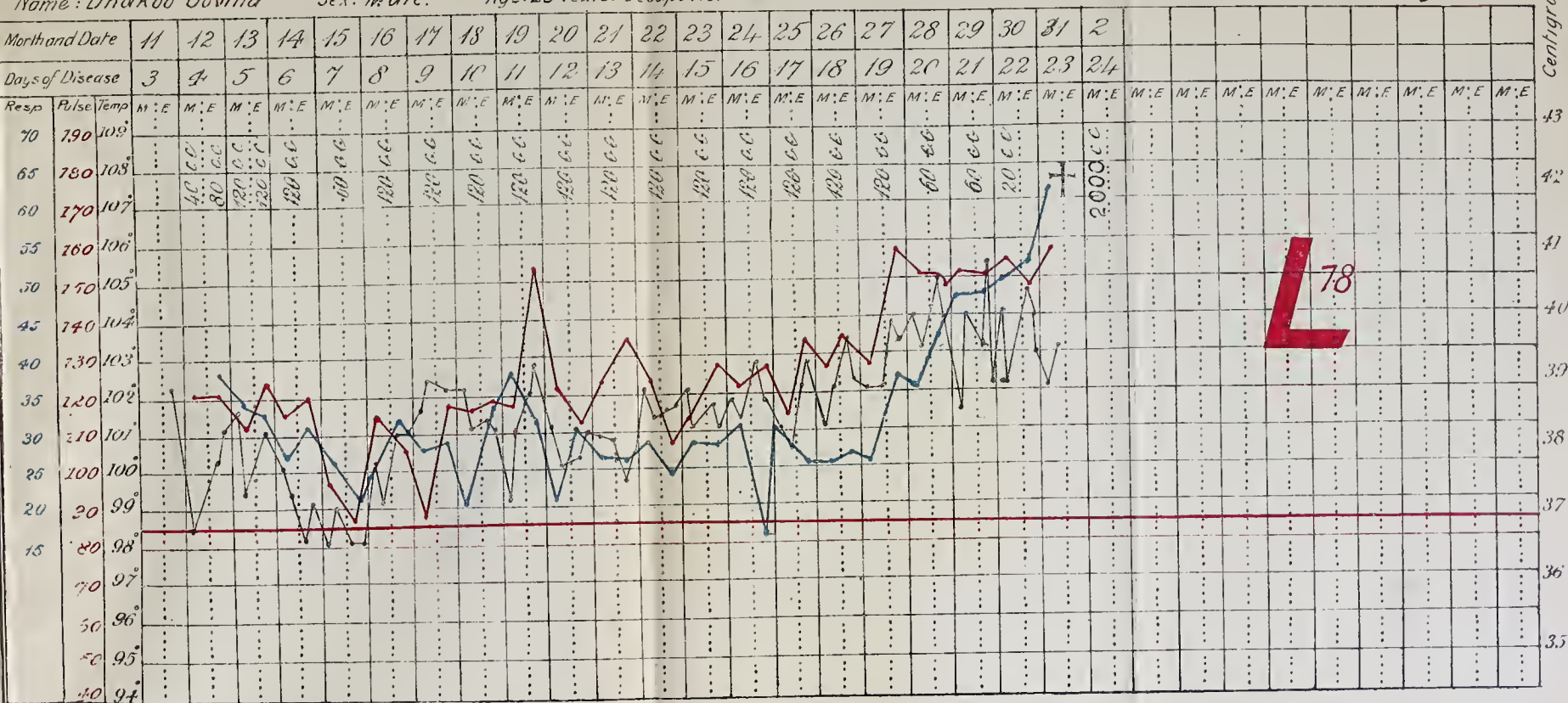
Name: Dhakoo Govind

Sex: Male.

Age: 20 Years. Occupation: Mill Hand

Caste: H. Vani

Previous Duration: 3 days.



Diagnosis **PLAGUE**

Previous Duration: 3 days

